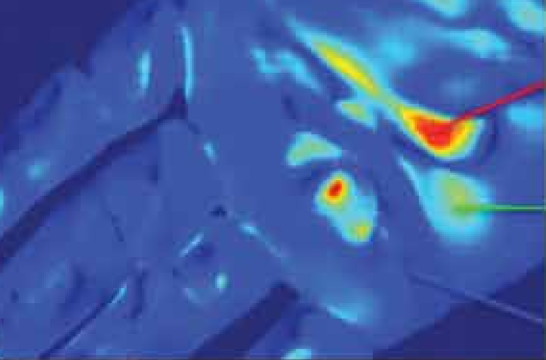

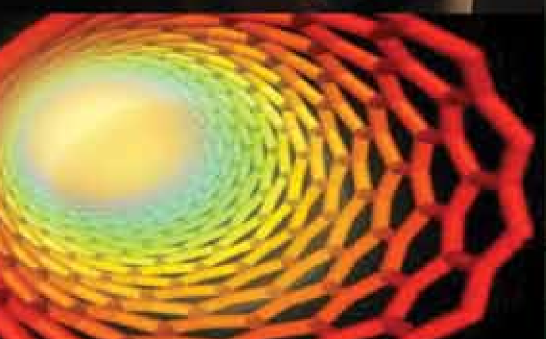


Phase II Grantee Abstracts

SBIR/STTR Phase II Grantees Conference
May 6-9, 2012
Renaissance Baltimore Harborplace Hotel
Baltimore, MD

PREFACE

The Small Business Innovation Research (SBIR) program and the Small Business Technology Transfer (STTR) program were conceived at the National Science Foundation (NSF). In 1976, Roland Tibbetts initiated an NSF program that would support the small business community with a specific objective to provide early-stage financial support for high-risk technologies with commercial promise. Today the government-wide program is administered by the Small Business Administration (SBA) and includes eleven federal departments that collectively award over $2 billion to small high-tech businesses.

NSF SBIR/STTR Program

The primary objective of the NSF SBIR/STTR Programs is to increase the incentive and opportunity for small firms to undertake cutting-edge, high-risk, high-quality scientific, engineering, or science/engineering education research that would have a high-potential economic payoff if the research is successful.

The current portfolio of NSF SBIR/STTR program covers three broad areas:
- **Biological & Chemical Technologies (BC)**
- **Electronics, Information & Communication Technologies (EI)**
- **Nanotechnology, Advanced Materials & Manufacturing (NM)**

NSF SBIR/STTR Phase II Grantees Conference

The annual NSF SBIR/STTR Phase II Grantees Conference is an opportunity for small businesses that have received NSF Phase II awards and supplements to:

- Share technical and commercial achievements with the NSF Program Directors
- Receive educational information that is critical for small high-tech start-ups
- Learn about the various supplemental funding opportunities
- Network with other NSF SBIR/STTR grantees as well as potential investors and strategic partners

In the spirit of networking and resource sharing, we have designed this abstract book as a resource to NSF Phase II grantees, potential investors and strategic partners. We also hope to provide a snapshot of the current portfolio of NSF SBIR/STTR program.

To learn more about NSF SBIR/STTR Program, visit our website at http://www.nsf.gov/eng/iip/sbir/.

IMAGES AND CREDITS

Cover (Top – Bottom)

Spectral MD, Inc., 1058146
Spectral MD's DeepView imaging system provides color image maps to aid physician understanding of subsurface blood perfusion. This technology has potential application in clinical conditions such as decubitus ulcers, skin flaps, burns and vascular deficiencies. Image shows the palmar arch of a healthy human hand. *Credit: Spectral MD, Inc.*

Independence Science, LLC, 1127412
Image shows the light sensor probe in use with the Talking LabQuest. This is a huge advancement for students who can not sense light, to experiment with the wonders of light refraction and many other experimental outcomes, they would have only heard described by a lab partner. *Credit: Cary Supalo, President, Independence Science*

Yuka Yoneda, "MIT Uses Carbon Nanotubes to Boost Lithium Battery Power 10x"
An intrepid team of researchers at MIT have made a remarkable find in lithium battery technology– by using carbon nan9otubes as one of a battery's electrodes, they can increase the amount of power it can deliver by up to 10 times (compared to a conventional lithium-ion battery). *Credit: MIT Uses Carbon Nanotubes to Boost Lithium Battery Power 10x | Inhabitat - Sustainable Design Innovation, Eco Architecture, Green Building*

SpringActive, Inc., 0956828
Odyssey at sunrise, a powered prosthetic ankle. *Credit: SpringActive, Inc.*

Absorbent Materials Company LLC, 1047699
Swelling of Osorb due to absorption as viewed by polarized light microscopy. *Credits: Lilianna Christman, College of Wooster and Paul L. Edmiston, ABS Materials Inc.*

Cover (Right)

Seashell Technology, 0924684
Picture of a nearly spherical water droplet that is placed on a painted surface that is superhydrophobic following treatment with a Hydrobead™ coating. The water contact angle is greater than 150 degrees and the water droplet sliding angle is less than 5 degrees. *Credits: Seashell Technology, LLC*

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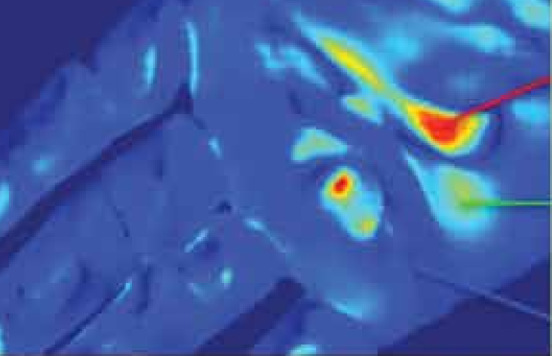

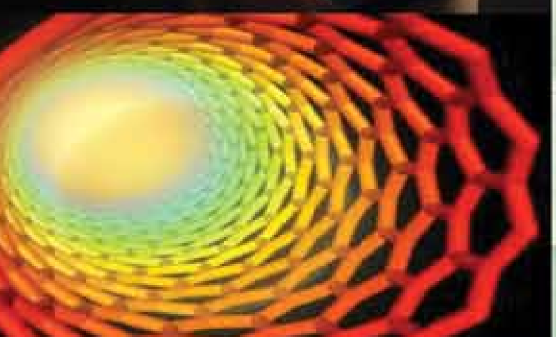

Biological & Chemical Technologies

Biological and Medical Technologies
Chemical Technologies
Environmental Technologies

Actuated Medical, Inc.

Phase II Award No.: 0923861
Phase IIB Award No.: 1238306

Award Amount: $654,000.00

Start Date: August 15, 2009
End Date: June 30, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Active Device for Reliable Cleaning of Feeding Tubes

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will continue development of the Tube-Clear(TM) device to clear clogged and sluggish feeding tubes, satisfying a critical medical need and reaching a viable commercial market. When compromised patients are unable to swallow food or medication, feeding tubes are used to administer medication and nutrition. A clog leaves the patient without medication or nutrition for hours, or even days, and is extremely frustrating to both patient and caregiver. Approximately 410,000 PEG (long-term) tubes and 5 million NG (short-term) tubes are placed each year in the U.S. Each type of tube presents specific challenges for feeding, clogging and cleaning. The Tube-Clear(TM) PEG prototype cleaned a clog of food and ground medication, in less than one minute, that could not be easily removed using any other available approach. Demonstration of the PEG alpha-prototype at four focus groups, for over 20 nurses from a variety of clinical settings, produced an overwhelmingly positive response toward the device. Phase II (following on Phase IB) will further develop both the PEG tube and NG tube cleaners to beta-prototypes, take the devices through clinical trials, and establish manufacturing protocols, all under a Food and Drug Administration compliant quality system.

The Tube-Clear will ease the burden on nursing staff and patients dealing with the frustration of clogged and sluggish feeding tubes. A structured financial and technical plan has been put in place using a combination of funds from SBIR (Phase I, IB, II and IIB), the State of Pennsylvania, Commercial Partners, and equity investment to reach specific milestones over a 2.5 year period. The NSF Phase I project kicked off this development effort with a highly successfully Alpha prototype for PEG tubes, which was tested in a series of nursing focus groups, resulting in extremely positive reviews. The Tube-Clear for PEG cleaning has an anticipated market launch date in 2010, followed by a NG tube cleaning device market launch in 2011. By 2013, Piezo Resonance Innovations (PRII) anticipates revenue for the Tube-Clear (TM) of $25-50 Million. Three commercial partners, with presence in the enteral feeding market, have indicated strong interest in the device and would provide access to their paths to market, marketing staff, and device development expertise. They have also expressed willingness to contribute financially, potentially as Phase IIB partners. PRII staff will also teach guest lectures on medical device design in the Penn State School of Nursing.

Affinity Biosensors

Phase II Award No.: 1127393

Award Amount: $499,861.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Rapid Assessment of Antibiotic Resistance by Mass Measurement

This Small Business Innovation Research Phase I project proposes to develop a "close-to-care" instrument that can assess antibiotic susceptibility of infection-causing bacteria in less than one hour. MEMS-fabricated sensors and integrated fluidics will measure the mass and growth rate of a small number of bacteria in-vitro with a resolution near 1 femtogram. By exposing the bacteria to a panel of antibiotics while monitoring growth rate, an infection's susceptibility profile will be determined very rapidly. Using this information, doctors will be able to select targeted antibiotic treatment much faster than is possible using conventional methods that require incubation and take 24 hours or longer - a crucial time savings. The platform will be validated on multiple E. coli strains that have a range of susceptibility, in both saline and healthy urine matrices. To demonstrate clinical value, the results will be compared to conventional methods. Additional tests will be performed on clinical isolates of E. coli and K. pneumoniae that cause urinary tract infections, and on MRSA (methicillin-resistant Staphylococcus aureus).

The broader impact/commercial potential of this project will be to improve medical outcomes of infection and to facilitate antibiotic stewardship. The rapidly expanding prevalence of resistant bacteria, combined with a decline in the discovery of new antibiotics, pose one of today's most dire health threats. More than 100,000 people die of infections each year in the U.S., behind only cancer and heart disease. There is unanimous consensus among infectious disease experts that rapid diagnostics to identify resistance are crucial for administering targeted antibiotic therapy, leading to better outcomes, and for minimizing the spread of resistant strains. The test to be developed here directly addresses these needs. The project targets UTI (urinary tract infections) that are responsible for the majority of hospital-acquired infections; and MRSA (methicillin-resistant Staphylococcus aureus) that kills more than 20,000 Americans every year. The platform will be configured for "close-to-care" use in microbiology labs found in most hospitals, and capture a significant fraction of the $500M U.S. market for susceptibility testing equipment and reagents. The platform also will address nearer-term markets in antibiotic discovery and laboratory research.

Apama Medical, Inc.

Phase II Award No.: 1127549

Award Amount: $499,400.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: An innovative ablation device for treating atrial fibrillation

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a novel ablation balloon catheter to perform radiofrequency ablation on atrial fibrillation patients. The intellectual merit of this project is in its use of an innovative approach to positioning, mapping, and ablation for atrial fibrillation patients, negating the need for excessive catheter rotations and/or serial point ablations. This new technology significantly reduces user variability, procedural time, and the resultant cost burden on the hospital, physician, insurance payer, and patient. The research objectives for this project are to design and develop an improved prototype that enables verification of balloon-to-tissue contact; design and develop a 2nd generation radiofrequency generator capable of powering 20 electrodes; refine catheter design to increase reliability/robustness and sheathing capability; and develop 2nd generation handle that allows for the balloon extension. All of these changes will be validated through in vitro and in vivo testing.

The broader impact/commercial potential of this project is an improvement in the treatment of atrial fibrillation, which is the most common heart rhythm disturbance encountered in clinical medicine, accounting for 1/3 of hospital admissions for cardiac rhythm disturbances. It is estimated that nearly 2.6 million individuals are currently afflicted with atrial fibrillation in the United States, with a projected increase to nearly 4.4 million people by the year 2030. Given the significant public health and economic impact of atrial fibrillation, there is an urgent need for practical and cost-effective approaches to treat atrial fibrillation. This technology aims to answer this need, providing an improved method of treatment for patients as well as highly-marketable technology that will save hospitals time and costs burdens.

ASL Analytical, Inc.

Phase II Award No.: 1058434

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Continuous Near Infrared Monitor for Pichia Pastoris Bioreactors

This Small Business Innovation Research (SBIR) Phase II project will further develop a fully hardened, user friendly ASL Pichia monitor for commercial protein production. The Phase I effort demonstrated the commercial feasibility of the continuous, real-time near infrared monitor for tracking metabolite levels and cell density during protein expression with Pichia pastoris. Implementing this technology into an industrial production or process development setting requires the entire system to be hardened and made more user-friendly. All hardware components will be incorporated into a single unit with an embedded computer and the sampling interface will be enhanced to permit continuous monitoring or discrete sampling. Protocols for calibration generation and updating will be established, and performance diagnostics to maximize calibration robustness developed. The final design of the instrumentation will be beta-tested by current Pichia users.

The broader impacts of this research will enable accurate control of bioreactors and enhance optimization efforts, resulting in maximum production yields of highly valued proteins from Pichia. Successful development of ASL's continuous, real-time monitor will enhance the attractiveness of Pichia as a protein expression platform. Acceptance of the monitor by the Pichia community will enhance efforts to develop new biopharmaceuticals and shorten the drug development process. ASL's monitor will catalyze the use of Pichia by enabling more effective control and optimization, thereby driving down healthcare costs and making these bio-therapeutic proteins more widely available. ASL's core monitor technology will be adaptable to broader markets with applications in biotechnology, biomedical, and clinical settings, where reliable, on-line sensing is currently unavailable.

BC Genesis

Phase II Award No.: 1026421

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Customizable Meniscus Implant Prepared by Dielectrophoretic Biofabrication

This Small Business Innovation Research Phase II project aims to develop a prototype meniscus implant of bacterial cellulose biomaterials fabricated by dielectrophoretic microweaving, an innovative biofabrication process. Nano-cellulose networks produced by the bacteria Acetobacter xylinum are biomaterials with unique hydrogel-like properties and biocompatibility that are ideal for cartilage tissue replacement. This technology is based on a new biofabrication process, in which bacterial motion is precisely controlled in an electric field to form nano-cellulose networks of desired morphology. Earlier feasibility studies have demonstrated bacterial cellulose deposition at the nanoscale during biaxial motion of bacteria in an electric field and the ability to control the assembly of cellulose layers into any desired three-dimensional architecture and control biomechanical properties. This Phase II project will develop a microweaver bioreactor for fabrication of customizable meniscus implants based on radiology images from patients. The structure and biomechanical properties will be evaluated in knee-model and compared with native meniscus. Biocompatibility and long term performance will be evaluated in large animal model studies.

The broader/commercial impact of this Phase II project, if successful, is the availability of meniscus implants that mimic the structure of the natural meniscus to address knee-joint failures, estimated to affect 15+ million people worldwide each year. Each year, in the US, more than 1 million people undergo meniscus surgery. Irreparable meniscus injuries often progress and lead to osteoarthritis. Currently, there is no satisfactory solution for irreparable meniscus injuries. The potential market for a meniscus implant is more than $3 billion. By developing a meniscus implant that can substitute for the injured native meniscus, it will be possible to prevent osteoarthritis and its related huge economic costs.

Bioo Scientific

Phase II Award No.: 0923854
Phase IIB Award No.: 1232791

Award Amount: $802,117.00

Start Date: August 1, 2009
End Date: June 30, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Improved in Vivo Delivery of SiRNA

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop technologies that optimize the use of RNA interference (RNAi) in animals. RNAi is an invaluable tool for characterizing gene function and is a promising candidate for gene therapy. The use of RNAi in tissue culture is well developed but is of limited use in experimental animals. RNAi agents must enter cells to exert their effects but this has proven to be challenging in animals. The current lack of such technologies is holding back the majority of important RNAi animal experiments. To open this bottleneck, kits and reagents will be developed based on Bioo Scientific's Targeted Transport Technology (T3). Easy-to-use RNAi delivery products will be manufactured, validated and commercialized for use in animal experiments.

The broader impacts of this research are twofold. First, researchers will gain ready access to products that greatly simplify the use of RNAi in animals, thereby, stimulating a burst of validation experiments in animals to try to replicate prior results derived from tissue culture experiments. Animals are more complex than their tissue culture counterparts and it is uncertain that results can be duplicated in an animal. Second, T3 has the potential to be used for the therapeutic delivery of RNAi agents. In sum, this project will propel the validation of tissue culture results via T3 enabled animal experimentation, leading to a better understanding of cellular pathways, the identification of novel drug targets, and the potential to deliver RNAi agents as drugs.

Bioprocessing Innovative Company, Inc.

Phase II Award No.: 1026648

Award Amount: $500,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

STTR Phase II: Engineering Clostridial Fermentation for Biobutanol Production

This STTR Phase II project will develop novel engineered Clostridia strains for fermentation and economically produce butanol as a biofuel from sugars derived from starchy and lignocellulosic biomass. The conventional acetone-butanol-ethanol (ABE) fermentation has low butanol yield (<25%), butanol concentration (<16 g/L), and reactor productivity (<0.5 g/L•h) due to a strong butanol inhibition, and the fermentation process is difficult to improve due to the complicated metabolic pathways and gene regulation involved in the production microorganisms, mainly Clostridium acetobutylicum.

The broader impact/commercial potential of the project is to produce butanol as a biofuel from sugars derived from starchy and lignocellulosic biomass. Biobutanol has great value as an alternative transportation fuel. There is a huge potential commercial and societal impact in improving yields and reducing costs of butanol production. The research and other activity proposed could lead directly to a marketable product and process and leads to several enabling technologies, including better manipulation of C. tyrobutylicum, further demonstration of strain improvements using the FBB, and others.

BioSentinel, Inc.

Phase II Award No.: 1127245

Award Amount: $416,365.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: De Novo Assays for Detection of the Proteolytic Activity in Botulinum Neurotoxin-Based Pharmaceuticals

This Small Business Innovation Research (SBIR) Phase II project proposes to complete development of a universal, in vitro assay for determining the enzymatic activity of botulinum neurotoxin (BoNT)-based pharmaceuticals. This assay, called BoTest Matrix A Assay, will enable standardized comparisons of different BoNT preparations, regardless of manufacturer. BoNTs are used in many different cosmetic and pharmaceutical applications due to their exquisite specificity for motor neurons and their long-lasting effects. Currently, the strength and quality of BoNT-based pharmaceuticals is assessed using a mouse bioassay where BoNT is injected into dozens of mice and a unit of activity depends on the rate or proportion of mouse deaths. Beyond the obvious concerns about animal testing, the variability of the mouse bioassay and the lack of suitable standards and uniform protocols among manufacturers put patient safety and clinical outcomes at risk. The proposed assay(s) will reduce the use of animals and will provide a method to uniformly assess the activity of BoNT-based pharmaceuticals, thus increasing patient safety and the likelihood of successful treatment.

The broader/commercial impacts of this research are improved procedures and protocols that would greatly increase patient safety while reducing animal testing. The BoTest Matrix Assay would be applicable to all stages of BoNT-based drug manufacturing, including quality control, quantification, stability testing, and decontamination testing at manufacturing sites, all applications that are currently performed with animal assays. In addition, the assay would be applicable for authenticity testing (against counterfeit drugs) at border control points and inoffice testing for high-dose procedures where toxin activity concentration is critical for clinical outcomes. The proposed technology would be also the first of its kind on the commercial market. Other commercially available assays for detecting BoNT activity are not suitable for assessing BoNT-based pharmaceuticals, because the stabilizers added to the pharmaceutical formulations interfere with those assays. The proposed technology could be further adapted for testing BoNT activity in highly complex matrices (e.g., blood, food, water). Thus, the assay's utility would extend into food, biodefense, and environmental testing.

BioTools, Inc.

Phase II Award No.: 1058581

Award Amount: $431,690.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Vibrational CD Microscopy for Characterizing Supramolecular Bio-Chirality

This Small Business Innovation Research (SBIR) Phase II project is focused on the creation of a new revolutionary imaging instrumentation that combines vibrational circular dichroism (VCD) spectroscopy with infrared (IR) spectral microscopy. VCD microscopy represents a new class of spectroscopic imaging diagnostic capable of measuring VCD images with millimeter to sub-millimeter spatial resolution. The recent discovery that long-range structural chirality in protein fibrils is characterized by unusually large and distinctive VCD spectra provides the backdrop for this project. None of the currently available techniques can characterize the fibrillation pathway or the final fibril state with the same ease and detail as VCD. VCD microscopy can be thought of as circular polarization contrast microscopy that is sensitive to long-range chiral order in localized regions of biological samples.

The broader impacts of this research are studies of the supramolecular chirality of fibrils. This product is not a small improvement of an existing technology but a distinctly new method of studying long-range biochirality that is more sensitive, provides more detail, and is easy and fast to use. A secondary, higher-impact long-term impact will be clinical research laboratories where this innovation can be used for the detection and characterization of amyloids in vivo, i.e. for tissue biopsies, rapid detection of amyloids and drug screening.

Bridger Photonics, Inc.

Phase II Award No.: 0956910
Phase IIB Award No.: 1240259

Award Amount: $439,301.00

Start Date: May 1, 2010
End Date: April 30, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

STTR Phase II: Compact Aberration Compensated Focus and Scan Control for Biomedical Sensors

This Small Business Technology Transfer (STTR) Phase II project will develop a commercial prototype of an aberration compensated focus control device. This device, based on a MEMS technology, will allow the user to deflect a deformable membrane mirror in a controlled manner in order to select a desired focal length. The device also features active control of low-order aberrations. This technology will enable the next generation of biomedical imaging devices for microscopy applications by enabling focus control and aberration correction in a simple, compact and low-cost sensor.

The broader impacts of this research are primarily in biomedical imaging. An industry partner is interested in using the technologys aberration correction capabilities to improve skin cancer detection with their confocal microscopy product line. Microscopy and endomicroscopy researchers at the University of Arizona have stated that this technology will be a valuable asset in their research in the fight against cancer. The company will also team with a recognized leader in MEMS technology to enable enhanced imaging capabilities, primarily for imaging in the field of ophthalmology.

Cambrian Innovation LLC

Phase II Award No.: 1127435

Award Amount: $500,000.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: Energy Efficient COD Removal and De-nitrification for Re-circulating Aquaculture Facilities with a Combined Bio-electrochemical Process

This Small Business Innovation Research (SBIR) Phase II project will optimize and pilot test a novel, energy-positive approach to de-nitrification for the global aquaculture industry. Recirculating aquaculture systems suffer from high wastewater treatment costs. Leveraging recent advances in bio-electrochemical systems, Cambrian's de-nitrification technology is capable of simultaneously treating chemical oxygen demand (COD) at end of pipe and nitrates in culture tank water while generating electricity directly. Phase I R&D demonstrated the existence of exo-electrogenic microorganisms in aquaculture wastewater. A flow through reactor consistently treated nitrate to below EPA drinking water concentrations (10mg/L) while removing an average of 65% of end-of-pipe COD and generating over 96 Amps/m3. An economic analysis demonstrated potential operating savings of over 70%, and significant bio-security benefits, versus competing systems. Phase II R&D will focus on optimizing treatment rates and reactor parameters with partner firms, and piloting a scaled reactor at an Aquaculture farm.

The broader impacts of this research are to introduce technologies and strategies that solve water and energy problems for the recirculating aquaculture industry. With the collapse of fisheries globally, the aquaculture industry is poised to fill an important gap in our food production. However, recirculating systems in particular are under pressure to limit environmental harm caused by water intensity and pollution. Bio-electrochemical systems represent a novel approach to turn waste resources into energy, thereby increasing farmer's bottom line and resolving the tension between economics and sustainability. Future research can broaden applications to other industries.

Carmot Therapeutics, Inc.

Phase II Award No.: 1127154

Award Amount: $500,000.00

Start Date: September 1 , 2011
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: A new drug discovery method to transform peptides to small molecules: proof of principle with p53-hdm2

This Small Business Innovation Research (SBIR) Phase II project creates a powerful drug discovery technology that uses an innovative fragment-based approach to identify small molecule inhibitors of difficult targets. Though many peptides can disrupt protein-protein interactions, conventional screening technologies are rarely successful at identifying small molecules that do so. In this project peptides are transformed into smallmolecule drugs through an iterative, systematic, empirical screening approach, whereby a small molecule can be evolved to harness key binding properties of peptide-based inhibitors. This proprietary technology, Chemotype Evolution, will be applied to the anticancer target p53-HDM2. The Phase I/IB grant demonstrated that peptides can be deconstructed into baits suitable for performing Chemotype Evolution. In Phase II, Chemotype Evolution will be used to convert these peptide-based baits into novel, potent, completely non-peptidic inhibitors of the p53-HDM2 interaction. Moreover, the flexibility of the technology will be increased by adding additional chemistries.

The broader impacts of this research are two-fold. First, the inhibitors discovered could lead to new drugs for treating cancer. Second, their identification will validate a drug discovery technology that can be applied generally to difficult targets. Routine transformation of peptides into small-molecule drugs would create a wealth of profitable opportunities. Scientifically, this technology will advance the field of molecular recognition and provide a rapid and cost effective method for creating chemical probes to investigate biological pathways. The societal impact will be substantial, as the technology will facilitate the discovery of drugs for unmet medical needs, particularly where conventional technologies have failed.

CertiChem, Inc

Phase II Award No.: 1026904

Award Amount: $507,425.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: Food Antioxidants (AOs) With or Without Estrogenic Activity (EA)

This Small Business Innovation Research (SBIR) Phase II project will use state-of-the-art assays to detect estrogenic activity (EA) and anti-EA in antioxidants (AOs). Chemicals like AOs that have EA or Anti-EA (EA**) produce adverse health effects, including reproductive and behavioral disorders and some cancers. AOs have not been examined for EA**, much less AO packages reformulated to have specific levels of EA for specific commercial applications. This project will assess the EA** of 10 additional organic AOs, and 15 EA-**Free/EA**-specified formulations made from combinations of conventional, organic, water-soluble, and oil-soluble AOs that are stable when exposed to common-use stresses. These AO formulations will be used by identified partners to produce animal feeds, cereals and other foodstuffs that are EA**-free or have well-specified levels of EA** providing a clear path to commercialization and additional patents.

The broader impacts of this research are that fetal or juvenile mammals, including humans, are especially sensitive to chemicals having EA** at very low dosages and should not indiscriminately ingest such chemicals. Conversely, other conditions (e.g., menopausal symptoms, some cancers or abnormalities of the prostate) are ameliorated by chemicals having controlled levels of EA**. Hence, this project will minimize the risks of unintentional consumption of chemicals having EA** by using EA**-free AOs in products such as cereals and baby formulas or specified-EA** AOs in products such as fitness drinks and dietary supplements for post-menopausal women.

Chemica Technologies Inc

Phase II Award No.: 1152661

Award Amount: $479,138.00

Start Date: April 15, 2012
End Date: March 30, 2014

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Innovative Green Technology for Advanced, Patient-Centered Home Hemodialysis

This Small Business Innovation Research (SBIR) Phase II project focuses on the further development of an advanced, mobile, easy-to-use, patient-oriented, advanced Home Hemodialysis (HHD) system that minimizes the use of water (less than 6 liters) and medical waste, and importantly, minimizes nutrient loss. End-stage renal disease (ESRD) is a devastating, disabling disease. Many ESRD patients and their family members are severely limited in the mobility and freedom due to the time and effort of having hemodialysis (HD) treatments at hospitals and dialysis centers. Our ultimate goal is to develop a next generation lightweight HD machine (~22 kg) equipped with high precision components and an innovative dialysate regeneration cartridge (DRC). This Phase II program focuses on the construction of a prototype HHD machine that is fully equipped with necessary functions and safety devices. The intellectual merits are based on both the highly efficient and selective DRC composed of a specifically functionalized sorbent, and the compact and highly efficient HD machine that allows for a well-configured and accurately controlled dialysis treatment. This development would greatly improve quality of life for ESRD patients and their families by allowing for effective and comfortable treatment at home, or even at work or school.

The broader impact/commercial potential of this project, if successful, is to reduce the economic burden of ESRD on both patients and Federal healthcare programs. As the number of HD patients approaches 3 million globally, it is becoming critical to decrease the cost and resource burden of treating these patients by drastically decreasing facility costs, use of water and energy in treatment. The second impact is to increase patients' quality of life by facilitating greater flexibility in the length and place of treatment (home, school, work). This system also allows for the personalized dialysis treatment of patients through selective adsorption of toxins. The proposed mobile, semi-portable HD machine offers many advantages over currently available dialysis systems, resulting in high commercial potential. The system will enhance the scientific and technical knowledge in the fields of bioengineering of dialysis and chemistry of sorbent technologies. Given the flexibility in dialysis treatment, the quality of life of dialysis patients will be greatly enhanced. Since this product achieves two goals simultaneously, namely improved treatment and reduced cost, it has a significant advantage over many of the competitive products available today.

ChromaDex Inc.

Phase II Award No.: 1058275

Award Amount: $500,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Microbial Production of Selected Anthocyanins

This Small Business Innovation Research (SBIR) Phase II project aims to develop and cost effectively manufacture natural anthocyanin colorants as alternatives to synthetic dyes. The food, dietary supplements and beverage market has decisively shifted towards utilizing natural colorants. Technologies available currently are not adequate to meet the current and projected demand for natural colorants cost effectively. The ChromaDex process utilizes microbial production techniques to manufacture high purity, low cost anthocyanins in large quantities for use as a natural colorant.

The broader impact of this research spans several industry segments. More and more synthetic dyes and colorants are being pulled from the marketplace due to health and safety concerns. Anthocyanin natural colorants eliminate the health and safety concern that is growing among consumers over the use of synthetic products in food and pharmaceuticals. These colorants can be utilized in natural dye sensitized solar cells, as anti-oxidant dietary supplements etc. Every pound of anthocyanin produced by the fermentation approach replaces an equivalent pound of synthetic colorant and helps to conserve the world's oil supply, protect the environment and provide safe food products.

Concurrent Analytical, Inc.

Phase II Award No.: 1026890

Award Amount: $381,132.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Sensitive, Rapid Heterogeneous Immunoassays Based on Surface Enhanced Raman Scattering and Gold Nanoparticle Labels

This Small Business Innovation Research (SBIR) Phase II project continues the development of an innovative diagnostic technology based on surface-enhanced Raman scattering (SERS) through its combination with gold nanoparticle labels, high-speed fluid handling, and sandwich-based immunoassays. This project, which builds on the successes of the SBIR Phase I effort, reflects a clear market need for high-speed, low-cost testing capable of providing rapid results commensurate with clinical diagnostic demands. As a market-entry point, the overarching goal is to create an extensible, multiplexed diagnostics platform for the causative agents of herpes: herpes simplex virus type 1 and type 2 (HSV-1 and HSV-2). Herpes has reached near pandemic levels in the United States and other countries around the world. The development of such a detection platform would have clear utility across the diagnostics marketplace, from the physician's office and in-hospital POC to third-party clinical diagnostic laboratories, as a multiplexed platform for sexually transmitted diseases and beyond.

The broader impacts of this research are realized with the development of a technique capable of providing absolute quantitation of HSV and many other viral diseases. Such a diagnostic tool would find a niche in large clinical laboratories, in research laboratories evaluating the antiviral efficacy of candidate vaccines, and with pathologists for defining infective pathogen thresholds, setting the stage for this technology to emerge as one of the premier tools in an arsenal of diagnostic technologies.

DNA Polymerase Technology, Inc.

Phase II Award No.: 1127479

Award Amount: $500,000.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Inhibition-Resistant DNA Polymerases and Other Improvements for Detection of Food-borne Pathogens.

This Small Business Innovation Research (SBIR) Phase II project proposes the development of novel enzymes (DNA polymerases) and other improvements for rapid detection of food-borne pathogens by DNA detection and amplification (PCR). PCR is a very fast and accurate method of pathogen detection, typically giving results in about a day, instead of several days required to grow and identify pathogens by cultural methods. But some foods, such as chocolate, dairy products, meat, and spices, contain components that inhibit the PCR assay. Current strategies for rapid pathogen testing in these foods include long cultural enrichment steps followed by dilution of inhibitors and/or labor intensive sample preparation (DNA extraction) to remove inhibitors. Inhibition-resistant DNA polymerases and food-specific PCR enhancers represent elegant, high-tech alternatives to dilution or DNA extraction. They could be integrated into existing rapid-detection systems to facilitate rapid accurate testing in inhibitory foods.

The broader impacts of this research are reducing the number and severity of outbreaks of food-borne illnesses in the United States due to early detection of food-borne pathogens. Faster, more accurate detection of pathogens will save time and money for food manufacturers, and reduce the need for costly product recalls. Technology developed here could also extend the disciplines of forensics, where recovery of small amounts of DNA in the presence of a variety of inhibitors is critical, and national defense, where rapid detection of biological agents used as weapons could save lives.

DNA Twopointo Inc.

Phase II Award No.: 0750206
Phase IIB Award No.: 1118452

Award Amount: $805,160.00

Start Date: March 15, 2008
End Date: February 28, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Multivariate Analysis of Heterologous Protein Expression

This SBIR Phase II research develops methods to improve the manufacture of recombinant protein products produced in foreign hosts. Cost-effective production of proteins generally utilizes organisms that are well-suited for protein engineering and large-scale production. Establishing a suitable production system for a protein is often a time-consuming, trial-and-error-based process and can be a significant barrier for the commercialization of a protein. In cases where production systems are found, they are often far from optimized due to the time and cost required as well as our current limited understanding of the critical parameters. In Phase I several gene design variables were assessed for their importance to protein expression in the bacterium Escherichia coli, a commonly used production organism. Data suggested novel means for gene optimization that were unexpected from conventional wisdom. In Phase II relevant gene design variables suggested by Phase I will be explored toward development of a refined model of the relationship of gene design to protein expression in E. coli as well as in other useful production organisms.

The broader impacts of this research are improved manufacturing techniques for recombinant protein based products. Protein products constitute a currently >$40 billion and rapidly growing world-wide market including industrial enzymes, diagnostic enzymes and protein pharmaceuticals. The tools developed from this project will drastically improve the speed, reduce the cost, and remove the uncertainties of modern protein manufacturing, which significantly limit this market. Improved production will also accelerate the study of proteins with therapeutic or otherwise marketable potential, expanding the field of candidate proteins for commercialization.

Echelon Biosciences, Inc.

Phase II Award No.: 1127467

Award Amount: $487,812.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: Near Infrared Substrates for Imaging Autotaxin Activity In Vivo

This Small Business Innovation Research (SBIR) Phase II project aims to further develop ATX-Red, an in vivo imaging agent that becomes fluorescent in the presence of the enzyme autotaxin. Autotaxin and its product LPA are involved in numerous biological functions that generally involve cell movement, and their dysregulation is associated with many diseases including cancer, fibroses, cardiovascular disease, and others. In Phase I ATX-Red generated highly informative images in living organisms, essentially 'lighting up' tumors. In Phase II ATX-Red metabolic stability will be improved and increased performance will be demonstrated. Then ATX-Red will be used to monitor progression and treatment of breast cancer and pulmonary fibrosis in mice.

The broader impacts of this research are improvements to basic research, drug discovery, clinical diagnosis and disease treatment, with the ultimate result being an improvement to human health. ATXRed will be an indispensible tool to the many basic research fields associated with autotaxin and LPA, where questions regarding autotaxin in vivo were essentially unanswerable prior to the development of this tool. In addition to its usage in the research arena, ATX-Red will aid development of therapeutics. Currently significant efforts are underway to develop drugs targeting autotaxin pathways. ATX-Red will likely be employed in the extensive in vivo experimentation needed to develop these compounds. Human patients also stands to benefit from this research, since ATX-Red could act as a companion diagnostic for pharmaceuticals targeting diseases associated with autotaxin dysregulation. Further clinical applications might include diagnosing disease and even directing surgical resection of tumors.

Echometrix, LLC

Phase II Award No.: 1152716

Award Amount: $493,860.00

Start Date: April 15, 2012
End Date: March 30, 2014

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Sector: Biological and Medical Technologies

SBIR Phase II: Acoustoelastic Tissue Property Evaluation of Selected Tissue Region in Dynamic Ultrasound Images

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a real-time ultrasound system for evaluating musculoskeletal soft tissue conditions by implementing the novel ultrasound post-processing software developed in Phase I into a programmable platform ultrasound system. Today, radiologists diagnose most musculoskeletal diseases by observing static MRI or conventional ultrasound images and considering key factors that support only qualitative, subjective assessments. Developing an efficient, real-time, quantitative method for diagnosing soft tissue (e.g., tendons and ligaments) injuries and monitoring healing can lead to more accurate diagnoses and reduce re-injury of incompletely healed tissues. The project will enhance the novel software technology's clinical utility and workflow efficiency. The original software will be enhanced by improving the software to automatically detect a region of interest with the ultrasound image. The registered regions of interest can be matched precisely from one patient visit to the next. Developing data mining software will further increase efficiency and accuracy by leveraging machine learning to assist with diagnostic decisions. These software improvements will be integrated with the platform ultrasound system to improve clinical workflow. The integrated product will both match the work flow efficiency of standard ultrasound and dramatically advance the utility of ultrasound within the musculoskeletal arena.

The broader impact/commercial potential of this project, if successful, will dramatically improve clinicians' ability to care for soft tissue injuries and will position the company to capitalize on (1) pressure to reduce medical imaging costs, (2) musculoskeletal specialists' growing interest in ultrasound, especially portable instruments, (3) a major ultrasound manufacturer's focus on the large and relatively untapped musculoskeletal ultrasound market, and (4) the recent emergence of quantitative ultrasound for non-musculoskeletal applications. This Phase II project will produce an efficient, real-time, quantitative method for diagnosing soft tissue injuries and monitoring healing. In the US alone, overuse injuries (strains, sprains) are the most frequently reported musculoskeletal injuries. Annually, 18.4 million such injuries cost approximately $92 B. Patients suffering from musculoskeletal injuries currently face three challenges at diagnosis, care, and outcome. First, current diagnostic methods, including MRI, ultrasound, or physical manipulation, rely on highly subjective and observer-dependent interpretation, so accuracy varies. Second, MRI is still the standard of care, but is far more costly than ultrasound. Substituting ultrasound for MRI, where appropriate for initially diagnosing musculoskeletal conditions, could save Medicare $736 M/year. Third, the lack of an objective monitoring method to determine when a patient can safely return to activity means patients risk missing unnecessary work time or re-injury.

EndoMetric, LLC

Phase II Award No.: 0956847

Award Amount: $565,735.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Real-time Analysis and Feedback during Colonoscopy to improve Quality

This Small Business Technology Transfer (STTR) Phase II project will develop an assistive software tool for endoscopists to have real-time feedback of objective quality for colon and potential polyp region examinations. The technology is aimed to reduce polyp miss rates during colonoscopy. Colonoscopy has contributed to a marked decline in colorectal cancer related deaths. However, recent data suggest that there is a significant miss rate for the detection of even large polyps and cancers. Studies suggest that polyp detection rate may be related to the duration of the withdrawal phase of the procedure and cancer miss rate is related to the identity of the endoscopist performing the procedure. This tool, which will provide video stream analysis and feedback during live colonoscopy, is made up of novel middleware software to ensure high performance execution of video analysis on an affordable workstation, and are generic, reconfigurable with new task allocation that support time-constraint video analysis. Objective metrics for real-time feedback are derived from real time analysis that will address complexities arising from blurry frames, stool, camera movement patterns, and regions of appendiceal orifice and polyps. Technical insights learned from development of this tool for colonoscopy may be applicable to new research on quality control using videos generated in other areas of medicine, such as bronchoscopy, cystoscopy, arthroscopy and laparoscopy.

The broader/commercial impact of this project, if successfully implemented in large-scale day-to-day medical settings, will be higher quality of care for patients undergoing colonoscopy procedures with real time objective quality assessment, which is currently not feasible. Over 14 million colonoscopies are performed annually in the US. This assistive tool will stimulate high quality inspection, while documentation is done. That will mean that endoscopists will be able to spend more time on performing the colonoscopy and less time on documentation. Hospital/clinic administrators will be able to run endoscopic facilities more efficiently. Insurance companies may benefit from better documentation and lower costs since fewer patients will require extensive cancer treatment as the frequency of missed polyps and early cancers declines. This assistive tool is also expected to contribute to medical education, research, and practice by providing automated feedback during teaching and training of novice endoscopists or continuing education for experienced endoscopists.

EN'URGA INC

Phase II Award No.: 0923865
Phase IIB Award No.: 1144334

Award Amount: $1,016,000.00

Start Date: August 1, 2009
End Date: July 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Line Scan X-Ray Tomography for In Cylinder Diagnosis

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to develop a sound and novel Line Scan X-ray instrument to characterize turbulent sprays and flames inside a windowless combustor. This project will develop and evaluate a prototype system that will be used by the automotive and gas turbine industries. The goal of the project is a commercially available diagnostic technique for obtaining detailed characteristics of flames and sprays inside windowless combustors.

The broader impact/commercial potential of this project is that it will enable industry to measure relevant information inside combustors, permitting stricter quality control and reduced pollution emission. Significant advances in the combustion process are required to enable quantum improvements in fuel efficiency. This diagnostic tool will provide the information critically needed to enable improvements in fuel efficiency and pollution reduction.

Equinosis LLC

Phase II Award No.: 1026883

Award Amount: $499,264.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

STTR Phase II: Inertial sensing of animal locomotion

This Small Business Technology Transfer (STTR) Phase II project proposes to further investigate use of a body-mounted, inertial sensor motion analysis system as a field-ready, objective evaluation technique to detect and evaluate locomotion disturbances in the horse. Research objectives involve incorporating the Hilbert-Huang transform into analysis algorithms, test another common gait, the canter, test unique gaits of popular breeds in the United States, expand application to detect and evaluate ataxia in horses and lameness in dogs, further investigate the ability of the system to differentiate impact from pushoff lameness, further investigate if specific, naturally-occurring lameness conditions can be differentiated by analysis, investigate the impact on analysis of adjusting for torso rotation, and investigate developing an additional data acquisition device for veterinarians to prescribe to clients as a monitoring tool.

The broader impacts of this research are improving veterinary service provided to horses and dogs and generally enhancing animal health and well-being. Education of veterinary students will be improved by basing teaching on objective measurement rather than subjective opinion. Accurate detection and evaluation of lameness in horses and dogs and ataxia in horses early in the course of disease may save money and improve therapeutic outcomes if treatment is initiated when it may be most effective and provide the practicing veterinarian with more objective evidence on when and what diagnostic modalities have the greatest potential to achieve accurate and specific diagnosis. Successful commercial development of this technology will stimulate the economy, providing a value-added service previously unavailable.

FiveFocal LLC

Phase II Award No.: 1127542

Award Amount: $452,469.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Real-time Camera Analysis and Process Tracking (ReCAPT)

This Small Business Innovation Research (SBIR) Phase II project will develop and test real-time process monitoring systems to support manufacturing of miniature digital cameras. Rapid growth in unit volume of digital cameras for cellphones and consumer goods has outpaced the industry's manufacturing process monitoring technology. Except for simple pass/fail outgoing quality tests, high volume camera manufacturers lack any system for in-line, real-time monitoring of production errors that cause low yields, high production costs, and delay new product introduction. The Real-time Camera Analysis and Process Tracking algorithm, ReCAPT, integrates with existing production equipment to identify manufacturing errors and trends before product quality is compromised. ReCAPT leverages outgoing QC data, along with novel design-aware algorithms to identify assembly and fabrication errors and improve the manufacturing process. The Phase II objectives include optimizing the data collection hardware and pre-processing software, automating and generalizing the algorithm initialization, and integrating ReCAPT into the production environment through improvements to the algorithm's robustness. With a key commercialization partner, ReCAPT will be tested multiple times in actual production environments with potential customers reviewing the results. The results will determine the achievable improvement in production efficiency, and quantify ReCAPT's economic value to manufacturers of digital cameras.

The broader impact/commercial potential of this project involves improving yields in the production of miniature camera lenses. Over one billion miniature digital cameras produced annually supply the explosive growth in cell phones and other mobile consumer electronics. The pursuit of cost reduction has led to development of wafer-level manufacturing where thousands of camera lenses are simultaneously fabricated, affixed to a wafer of image sensors and then diced, potentially eliminating the need for individual component assembly. By improving yields and lowering costs, ReCAPT will enable the rapid adoption of wafer-level and other automated, capital intensive camera manufacturing technologies. The broader impact is the development of manufacturing technologies that rely on automation and precision engineering instead of manual labor, enabling US companies to gain traction in the growing $15 Billion annual digital camera market. The statistical manufacturing process data supplied by ReCAPT enables real-time control of manufacturing, reduces new product risk, and allows more aggressive development of innovative camera technology. Sold as an enhancement to existing automated manufacturing equipment, the ReCAPT software product will increase profit for component manufacturers, improve product performance and performance consistency for consumer goods manufacturers.

GC Image, LLC

Phase II Award No.: 1127264

Award Amount: $499,976.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Sample Classification and Biomarker Discovery by Comprehensive Metabolomic Analysis

This Small Business Innovation Research Phase II project proposes to develop a system for automated classification of biological samples and discovery of biomarkers. The system will be designed to perform comprehensive pattern analysis of state-of-the-art biochemical separations generated by comprehensive two-dimensional chromatography (GCxGC) with high-resolution mass spectrometry (HRMS). The pairing of GCxGC and HRMS combines highly effective molecular separations with precise elemental analysis. A critical challenge for effective utilization of GCxGC-HRMS for biochemical sample classification and biomarker discovery is the difficulty of analyzing and interpreting the massive, complex data for metabolomic features. The quantity and complexity of the data, as well as the large dimensionality of the metabolome, and the possibility that significant chemical characteristics may be subtle and involve patterns of multiple constituents, necessitate investigation and development of new bioinformatics. The principal technical objective is an innovative framework for comprehensive feature matching and analysis across many samples. Specifically, the framework will incorporate advanced methods for multidimensional peak detection, peak pattern matching across large sample sets, data alignment, comprehensive feature matching, and multi-sample analyses (e.g., classification and biomarker discovery) with large sample sets. The anticipated result is a commercial system for automated multi-sample analysis.

The broader impact/commercial potential of this project will be realized through improved informatics for biological classification and biomarker discovery. These tools will enable researchers to better understand biochemical processes and to discover metabolic biomarkers, which could lead to improved methods for disease diagnoses and treatments. These information technologies will foster utilization of advanced GCxGC-HRMS instrumentation, thereby contributing to the impetus for future instrument development. The informatics developed in this project also will be relevant for other classification problems involving multidimensional, multispectral data, including other applications (such as biofuels), other types of chemical analyses (such as multidimensional spectroscopy), and other fields (such as remote-sensing multispectral geospatial imagers). This project will contribute to national competitiveness in the global market for analytical technologies and will contribute to workforce development by involving students in research experiences through internships and student projects. Software developed in the project and an example dataset will be available to educational institutions to allow students to more easily explore biochemical complexity.

HEPREGEN

Phase II Award No.: 0956888
Phase IIB Award No.: 1240250

Award Amount: $500,000.00

Start Date: January 15, 2010
End Date: June 30, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Development of a human liver platform for high-throughput screening of drug-induced liver injury and drug-drug interactions

This Small Business Innovation Research (SBIR) Phase II project is aimed towards development of a human micro-liver platform and assay technologies for cost-effective, high-throughput, and quantitative screening of drug-induced liver injury (DILI) and drug-drug interactions (DDI) following chronic exposure to pharmaceuticals. While primary human hepatocytes isolated from the liver are widely utilized in the pharmaceutical industry for drug screening, these cells rapidly (hours) lose phenotypic functions under conventional culture conditions. Recently, a human liver tissue model with defined microscale architecture has been developed that maintains phenotypic functions of primary hepatocytes for several weeks in vitro (micro-livers). This project proposes to develop assay technologies (gene expression, reporter-based, and high content imaging) with micro-livers in a high-throughput multi-well format for DILI and DDI screening in early drug discovery.

The broader impacts of this research are novel approaches for the development of high-throughput, physiologically-relevant platforms for assessing the potential of compounds to cause adverse effects on organs. The liver platforms developed here may enable the elimination of drugs with problematic toxicity profiles much earlier in the drug development pipeline towards substantially reducing the cost to develop a successful drug ($1 billon per drug), increasing the likelihood of clinical success, and limiting human exposure to unsafe drugs. In the future, these platforms may be useful for evaluating the injury potential of environmental toxicants, in fundamental investigations of liver physiology and disease, and for personalized medicine.

Insite Medical Technologies

Phase II Award No.: 0848916
Phase IIB Award No.: 1112846

Award Amount: $1,000,000.00

Start Date: January 15, 2009
End Date: June 30, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Improving the safety and efficacy of epidural anesthesia

This Small Business Innovation Research Phase II project is focused on commercializing a proprietary medical device to provide safe and accurate delivery of epidural anesthesia. Epidural anesthesia provides excellent pain control for childbirth, major surgery, and chronic back pain without having to expose patients to the risks of general anesthesia. Epidural anesthesia involves (1) accessing the epidural space, a miniscule potential space adjacent to the dura, the thin protective covering of the spinal cord, then (2) delivering local anesthetic to bathe the spinal nerve roots and block pain sensation. Currently, epidural access requires blind insertion of a sharp-tipped needle through the back that is immediately halted just prior to entering the dura. The difficulty of the current method poses risks of anesthetic delivery to incorrect anatomic locations and injury to nearby critical structures. Complications are estimated to occur in 6-25% of cases. InSite Medical Technologies has developed a technology that eliminates the sharp needle tip and provides highly controlled access to the epidural space by uniquely engaging surrounding tissue. During the Phase II project InSite will finalize product design, establish a quality manufacturing system, attain an FDA 510(k) approval and achieve the first human use of the device.

The epidural anesthesia market comprises an estimated 9.8 millions eligible patients each year in the United States of which only 3.4 million patients actually receive epidural anesthesia. The underutilization of epidural anesthesia results from several barriers including procedure difficulty and physician fear of complications. The epidural anesthesia market is segmented into obstetric, surgical, and chronic pain applications. With over 4 million births annually in the United States, obstetrics is the largest segment. Currently, during childbirth, 2.4 million women (60%) receive epidural anesthesia for pain control. The second largest segment is surgical anesthesia where, despite known patient-outcome benefits, epidural anesthesia is used in only 500,000 of 1.8 million eligible cases. Finally, spine-related pain syndromes are treated increasingly with epidural steroids and implanted stimulators, accounting for 600,000 annual cases. Outside the U.S., 19 million epidural access procedures are performed annually with a massive potential international market including 130 million births per year. By creating a safer and more accurate system for delivering epidural anesthesia, InSite Medical Technologies sees an opportunity to produce a premium medical device that positively impacts patients' experience with epidural anesthesia.

Kampachi Farms

Phase II Award No.: 1026645

Award Amount: $516,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Launching Velella: Testing the Commercial Potential of Mobile Offshore Fish Farming In Ocean Gyres

This Small Business Innovative Research (SBIR) Phase II project will catapult open ocean mariculture far offshore, away from the restrictions caused by competing user groups, site lease requirements and mooring restrictions, by developing the technology for Velella, an untethered, open ocean regional drifter cage. Since 2005, Kona Blue's open ocean mariculture operation has produced up to 500T per annum of Kona Kampachi, with negligible environmental impacts, from a 90 acre site. Growth and investment are constrained by site limitations. Mariculture expansion in U.S. waters is similarly limited by regulatory constraints for moored structures, and the technological challenges of operating further offshore. The Velella Project is developing essential technologies for drifter net-pens that can be entrained in regional ocean eddies. This will allow increased scale and reduced labor requirements, and greater farm profitability. Phase II will also expand eddy predictive capabilities, and launch a Velella beta-system maiden voyage.

The broader impacts of this research are to be accrued through benefits to the environment, coastal economies and public health. The oceans are in deep trouble; over 90% of the ocean's larger predator fish are gone, and over a quarter of fish stocks have 'collapsed'. Heavily exploited or overfished wild stocks cannot meet the growing global demand for healthful seafood. Still, increased seafood consumption is imperative for American consumers' health. Inshore and onshore aquaculture offer only limited expansion opportunities, or lower-value products. Open ocean mariculture can meet this burgeoning demand, improve product quality and reduce pressure on wild stocks. Overcoming the industry constraints requires highly-automated husbandry systems, and demonstration of a scalable production model for deep water that meets current regulations. This research could significantly expand sustainable, eco-friendly mariculture in U.S. waters, without environmental impacts or user-group conflicts associated with other site-constrained aquaculture. Increased automation can increase production volumes and improve profitability, fish health and worker safety offshore. Increased domestic mariculture could reduce America's $9 billion seafood trade deficit.

Louisville Bioscience, Inc.

Phase II Award No.: 1026824

Award Amount: $499,826.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Plasma Thermograms for Disease Detection and Monitoring

This Small Business Innovation Research (SBIR) Phase II project will develop a powerful new diagnostic assay platform that will form the basis of a novel high-throughput diagnostic assay for detection and differential diagnosis of six autoimmune diseases: Lupus, Rheumatoid Arthritis, Multiple Sclerosis, Scleroderma, Polymyositis, and Lyme disease. Assay output is a differential scanning calorimetry (DSC) thermogram that is a characteristic signature for an individual's plasma or serum. The characteristic pattern provides a quantitative measure of the manifold components comprising an individual's plasma/serum, thereby providing an entirely new metric with which to analyze the fluids. The goal is completion of the necessary R&D objectives required to build a prototype diagnostic assay based on the plasma thermogram technology platform. Activities and experiments are directed at automating and optimizing laboratory assay capabilities; defining essential assay parameters and quantitative metrics; and testing and validating the prototype assay.

The broader impact/commercial potential of this project is the radical alteration of treatment paradigms, improved patient outcomes and reduced costs of patient care for complex diseases like autoimmune diseases. As many as 24 million people in the USA are affected by autoimmune disease. Convenient, quantitative and cost-effective diagnoses for numerous diseases, including targeted autoimmune diseases are not readily available. Early differential diagnosis between these diseases is an important unmet medical need and critical for timely and accurate treatment of disease and its complications. In addition, early accurate diagnosis potentially mitigates the costs and inconvenience associated with redundant administration of the current immunological, serological, clinical and pathological tests. Thus, a non-invasive blood assay like the plasma thermogram test that can differentially diagnose autoimmune diseases will be highly beneficial. The company will establish a CLIA (Clinical Laboratories Improvement Act) laboratory from which to market and sell the plasma thermogram test. A central laboratory offers a fast, low cost and high revenue business model for introducing new diagnostic tests into the marketplace. Commercialization of the thermogram technology platform represents a potential multi-million dollar market opportunity.

Lucigen Corporation

Phase II Award No.: 1058238

Award Amount: $516,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Molecular Diagnostics and Biological Control of Disease in Farmed Channel Catfish

This Small Business Innovation Research (SBIR) Phase II project is aimed at developing an effective, inexpensive, safe means of controlling diseases in farm-raised catfish. One of the biggest problems in farm-raised catfish is disease that occurs in commercial ponds. Scientists at Auburn University discovered strains of natural bacteria that can be applied to fish feed to control the most common diseases. Lucigen is developing rapid, simple tests capable of detecting these diseases before the fish get sick. The goal is to combine these ideas to develop commercial products to rapidly diagnose and treat the most common catfish diseases.

The broader impacts of this research are 1) the preservation of an important industry in economically disadvantaged regions of the rural southeastern US and 2) protection of an increasingly important food source. Since yields of most wild-caught fish are declining, farmed fish are becoming an important food source and an important industry throughout the world. Fish diseases in aquaculture ponds cause losses of up to half the fish before harvest, costing billions of dollars worldwide, and there is no satisfactory means of controlling most of these outbreaks. Antibiotics, vaccines, chemicals or controlled feeding are all prohibitively expensive, harmful to human and environmental health and/or bad for yields. The detection and control of catfish diseases, the immediate focus of this project, addresses the $20-30M in annual losses caused by disease. Longer term, similar biological control systems should be applicable to other fish species in the US and the rest of the world.

Lumicell Diagnostics, Inc

Phase II Award No.: 1152489

Award Amount: $494,168.00

Start Date: April 15, 2012
End Date: March 31, 2014

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Intraoperative Detection and Ablation of Microscopic Residual Cancer in the Tumor Bed

This Small Business Innovation Research (SBIR) Phase II project is aimed at developing a handheld system that a cancer surgeon uses to detect and eliminate microscopic residual cancer in the tumor bed after gross resection of the tumor. An integrated laser ablation system instantly removes the cancer cells identified by the imaging system during surgery, eliminating the need for repeat surgery. Effective resection of cancer is often difficult because of the need to spare essential tissue (blood vessels, nerves, brain) adjacent to the tumor and the lack of visual resolution of the tumor bed during manual resection. The integrated laser ablation system developed in Phase II will enhance the surgical technique by quickly and precisely eliminating residual cancer cells in the tumor bed. The objective of Phase II is to deliver a system ready for clinical trials, which includes: increasing the ablation speed, developing a larger field of view, and demonstrating efficacy in animal studies. After completion of this program, Lumicell will validate the performance of the novel system in human clinical trials.

The broader impact/commercial potential of this project stems from improvements in patient care and reduction of healthcare costs. Currently, around 50% of breast cancer patients and 35% of sarcoma patients require second tumor de-bulking surgeries because a final pathology report returns days after the initial surgery indicating that residual cancerous cells have been left within the patient. Furthermore, 25% of the final pathology reports do not detect residual cancer cells due to sampling errors fundamentally inherent in the process. Thus, most patients require subsequent medical therapy including additional radiation or chemotherapy treatment to prevent cancer recurrence and metastasis stemming from residual cancer cells. The system is designed to find and destroy residual cancer cells in real-time at a single cell level. Tumors adjacent to critical nerve or brain tissue are particularly difficult and a laser therapy guided by the proposed imaging system would allow the surgeon to thoroughly eradicate cancer cells with minimal added work and no adverse effect on surrounding tissue. Lumicell's novel single cell imaging device combined with focused laser ablative therapy will have a significant impact on preventing second surgeries and subsequent medical therapy resulting in significant healthcare cost savings and improved patient care.

Lumiphore, Inc.

Phase II Award No.: 1152688

Award Amount: $499,674.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Biological and Medical Technologies

SBIR Phase II: Time-Resolved Fluorescence (TRF) Microscopy of Live Cells with Cell-Penetrating Peptides and Other Targeting Agents

This Small Business Innovation Research (SBIR) Phase II project addresses challenges found with the current methods of microscopic imaging of protein-protein interactions in living cells. These methods rely extensively on Förster Resonance Energy Transfer (FRET) between cyan (CFP) and yellow fluorescent proteins (YFP). These methods are problematic, due to the interference from background noise and the intrinsic photophysical properties of these fluorophores. We have developed a system that uses a lanthanide complex donor in combination with time resolved fluorescent microscopy, which overcomes these limitations. The research objectives of this project are to expand the capability of these luminescent probes, as well as scale-up in order to provide enough material to meet manufacturing needs for initial product sales. By the end of the project, we will have reagents for performing site directed time-resolved measurements in live cells and an operational prototype time-resolved imaging module.

The broader impact/commercial potential of this project, if successful, is the potential to develop a new class of cell imaging reagents and techniques. This innovation will improve the ability of researchers to follow protein-protein interaction pathways with quantitative accuracy that has not been available before. This will impact not only fundamental and applied research but also primary healthcare through the discovery of novel pharmaceutical targets and mechanisms to diagnose and treat disease. The design and use of novel probes to study structure and function at the molecular and subcellular level in living cells is a topic of great importance, with a growing need for new approaches and tools to visualize not only the distribution of molecular species in cells, but the manner in which they interact. Protein-protein interactions and other dynamic events within cells have been largely invisible, but will be increasingly observable with new imaging modalities. In particular, lanthanide probes, with the dramatic lowering of background achieved through time-gating can enable new microscopic imaging, if successfully coupled with cell penetration and molecular targeting and recognition. This new scientific capability is certain to have significant commercial appeal and adoption in the basic science and medical research markets.

M4 Sciences, LLC

Phase II Award No.: 0822879
Phase IIB Award No.: 1027591

Award Amount: $1,029,660.00

Start Date: July 1, 2008
End Date: June 30, 2012

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Program Director: Prakash Balan

Sector: Biological and Medical Technologies

STTR Phase II: Modulation-Assisted Deep Hole Drilling of Micro/Meso-Scale Biomedical Components

This Small Business Technology Transfer (STTR) Phase II project aims to develop a Modulation-Assisted Machining (MAM) system with novel capabilities for micro/meso-scale deep-hole drilling of biomedical components. The system is structured around a new device; an accessory developed for computer numerically controlled (CNC) machine tools. This new device superimposes a low-frequency sinusoidal modulation onto machining processes enabling controlled chip formation and easy disposal, enhanced lubrication of tool-chip contact, reduces energy consumption, and, potentially, a reduction in tool wear. When implemented in the appropriate system framework, unprecedented increases in productivity and efficiency of deep-hole drilling processes are envisaged.

The broader impact/commercial potential of this project will be commercialize MAM technology in manufacturing of biomedical components and related applications in automotive and aerospace fluid systems manufacturing. Complemented by a strong education and training program. By driving the development of a class of clean machining processes with reduced effluent streams and energy consumption, and improved efficiency, this project will impact sustainable manufacturing for the discrete products sector, with broad societal benefits.

MBMR Biolabs Inc.

Phase II Award No.: 1152557

Award Amount: $499,824.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Biological and Medical Technologies

SBIR Phase II: In vivo Fluorescence Imaging Kit for Cell Proliferation.

This Small Business Innovation Research (SBIR) Phase II project proposes to develop an in vivo fluorescent imaging kit for cell proliferation that addresses the need to study cell growth processes in real time. Proof-of-concept has been demonstrated for a novel method of imaging DNA replication in vivo that is non-toxic and does not interfere with cellular metabolic processes. The method utilizes the unique specificity and high rate of reaction of bio-orthogonal ligation chemistry, and it has shown that in vivo labeling of DNA molecules with this novel bio-orthogonal mechanism yields fast, precise labeling of cell proliferation of cells in their natural environments. Most importantly, the method is minimally invasive, results in reliable incorporation of both the nucleotides and the label, and does not require cell lysis, DNA strand separations, or any of the abrasive treatments characteristic of cell proliferation assays currently on the market. The company plans to develop new methods for the usage of its technology with Fluorescently Activated Cell Sorting (FACS) protocols and testing different formats, such as tissues and different cell lines, for the applicability of this method.

The broader impact/commercial potential of this project, if successful, is a Fluorescent Imaging Kit that can be routinely used with such advanced techniques as high content screening, high throughput screening for drug-discovery, and ADME-TOX assays, as well as with more traditional cell biology and molecular biology settings. The unique advantage of the proposed product is that it allows cell monitoring over prolonged time periods, up to several days. The product will have applications in multiple scientific disciplines, from cancer biology to stem cell biology, and streamline experimental protocols. The proposed assays are especially tailored to be fully compatible with high content screening, one of the major technologies at the forefront of personalized medicine, most notably in the field of oncology, and as such it will directly contribute to the advancement of new therapies, better diagnostics, and more efficient treatment plans. The method also will allow cutting costs of reagents by eliminating the need to repeat experiments multiple times to monitor different markers, and by streamlining research aspects of early stage drug discovery.

Medipacs Inc

Phase II Award No.: 0848528
Phase IIB Award No.: 1042566

Award Amount: $1,182,875.00

Start Date: January 15, 2009
End Date: December 31, 2012

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

STTR Phase II: Dendritic Hydrogel Actuators for a Liquid Drug Delivery Patch

This Small Business Technology Transfer Phase II project will develop a class of new, stable, highly responsive Electro Active Polymer (EAP) hydrogel actuator materials. Incorporating dendrimers (dendritic macromolecules) and hyper branched polymers as chemical cross-linking agents into a poly(ethylene glycol) (PEG)-based EAP hydrogel to increase cross-linking densities at low polymer concentration will introduce systematic control of physical properties and performance through structural variables provided by the dendrimer (e.g. generation; end groups; branching ratio; subunit structure). Our research objectives involve the preparation of dendrimer containing PEG hydrogels and the investigation of dendrimer mole fraction, structure, and molecular weight on the stability, strength, physical and responsive properties of the hydrogel material. The new hydrogel actuator materials will enable low cost miniature infusion pump technology. These actuators will be the pump mechanism of a disposable (low cost), small patch like, device being commercialized by Medipacs as the Mini Infuser.

The Mini Infuser is a miniature, disposable, programmable drug delivery device designed to significantly lower the cost of patient care while improving a patient's lifestyle with increased pharmacological safety, patient mobility and fewer needle sticks. Medipacs is collaborating with the University of Arizona Chemistry Department to develop the first generation commercial prototype in the Phase II project. Broad application of this technology will impact and lower the cost of healthcare not only for millions of infusion patients but also the industry providers. The projected market in the United States alone is greater than $3 billion. The impact to poorer regions though out the world is immeasurable; life-improving drug therapies such as low cost continuous insulin delivery will be enabled and become available for the first time to patients within these regions.

Nano3D Biosciences, Inc.

Phase II Award No.: 1127551

Award Amount: $500,000.00

Start Date: August 15, 2011
End Date: July 31, 2013

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: In Vitro 3D Tissue Model for Toxicity Screening and Drug Discovery

This Small Business Innovation Research (SBIR) Phase II project will use in vitro three-dimensional (3D) cell culturing enabled by the magnetic levitation method (MLM) as an improved tool for toxicity testing. This work will probe the effects of common agents on the lung, liver and kidney, three organs that play a central role in drug metabolism and are predisposed to toxic injury. 2D cell culture, commonly utilized for testing the cytotoxic effects of drugs, displays limited accuracy in predicting toxicity in vivo due to fundamental differences in the cellular microenvironment. While better representations of the 3D architecture of in vivo tissue are provided by animal models, they fail to accurately reflect whether or not drugs will cause cellular damage in humans as a result of biological differences between species. Our preliminary data shows that magnetic levitation maintains cells in culture in an arrangement that allows the cells to develop and communicate in a manner that is much closer to the in vivo environment than other in vitro systems.

The broader impacts of this research are to improve assessment of drug toxicity and chemical hazards, reduce the use of animals, and advance the fields of in vitro toxicology testing and drug discovery. Commercial potential includes expansion of the device into high-throughput screening, generation of a prototype of a gas delivery system with capabilities to perform live cell microscopy, and development of a label-free viability assay for drug discovery and toxicity testing.

NovaScan LLC

Phase II Award No.: 1058413

Award Amount: $506,074.00

Start Date: February 1, 20111
End Date: January 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Electrical Property Detection of Residual Cancer in the Surgery Suite

This Small Business Innovation Research (SBIR) Phase II project aims to bring to market a hand-held probe used by the surgeon to ascertain that the surgical wound and regional lymph nodes are clear of cancer. This technology will provide a highly innovative, rapid and accurate device for detecting cancerous tissue by interrogating the electrical properties of the tissues. Currently, removal of affected tissue must be confirmed in the pathology laboratory resulting in delays of up to 36 hours. If the residual cancer is left undetected the patient may be subjected to multiple surgeries or worse, may have a reoccurrence of the disease. This innovative technology will provide surgeons with a tool to ensure all cancer is removed, assist pathologists to help identify malignancies, and provide better results for breast surgery patients to avoid second or third surgeries.

The broader impacts of this research will be the development and implementation of a novel, accurate, rapid, inexpensive, non-invasive, low power, hand-held probe that can assist the surgeon in the removal of all of the cancerous tissue and assist the pathologist in the diagnosis of specific tumor regions. Cancer is a major health problem in the US with over 1.4 million new cases and 560,000 deaths at a cost of $72 billion each year. In particular, the detection of breast cancer has serious drawbacks: cancer is hard to find in dense breast tissue, often depend on the use of invasive contrast agents, and advanced detection technologies are expensive and not available to the entire population. In addition, some types of tumors are not easily identifiable. Surgical procedures are safe only if all cancer is removed. Clearly, there is a pressing need for new technologies that would improve the detection of cancerous tissue.

Nuvogen Research

Phase II Award No.: 1127476

Award Amount: $364,588.00

Start Date: December 15, 2011
End Date: November 30, 2013

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: Gene Signature Screening for Pancreatic Cancer Therapeutics from Sonoran Desert Extracts

This Small Business Innovation Research (SBIR) Phase II project is to address the high lethality of pancreatic cancer. Screening has begun with Phase IB funding, of natural products from the Sonoran Desert that have produced other promising drug candidates, testing effects on human pancreatic cancer cells. The objective of Phase II is to develop a drug candidate that alters expression of selected pancreatic cancer-related genes and that kills pancreatic cancer cells that express those genes. The drug candidates will be developed using a personalized medicine approach. The gene expression profiles (or genomics patterns) for many different pancreatic cancer tumors will be matched to the effects on genomics produced by the drug. This personalized approach could translate directly to clinical trials to pre-select patients most likely to respond to the drug.

The broader impacts of this research are first to reduce deaths due to pancreatic cancer, which ranked fourth among the leading causes of cancer death with 35,240 deaths in the US in 2009. The 5-year survival rate for patients with metastatic disease is 1.8%. The societal impact and commercial value of targeting such a lethal disease are very high. Further, the personalized medicine approach to drug development will impact many oncology projects. The idea of matching each patient's genomics patterns with each drug that targets that pattern will be critical. Each kind of cancer is not one disease, but a wide spectrum of accumulated genomics changes that have to be addressed individually.

Parabon NanoLabs, Inc.

Phase II Award No.: 1026606

Award Amount: $500,000.00

Start Date: September 1 , 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Nano-scale Engineering via Grid-scale Computing: Designing, Optimizing and Manufacturing Cancer Therapeutics

This Small Business Innovation Research (SBIR) Phase II project will advance the development of new drug compounds for the treatment of glioma, which have been designed and constructed with an innovative combination of grid-powered, computer-aided design (CAD) software and DNA nano-fabrication technology. The compounds are self-assembling DNA nanostructures functionalized with molecular subcomponents for targeting and destroying malignant glioma (brain) tumors. Prognosis for glioma is poor because complete surgical resection is impossible and chemotherapy (being poorly selective) leads to collateral brain damage, hence treatments are needed that target and destroy glioma cells with high specificity.

The broader impacts of this research are the societal benefits associated with improved disease outcomes through the creation of revolutionary new nano-pharmaceuticals. The Company's efforts under this project are focused initially on creating an effective treatment for glioma, but the Company's Essemblix platform has the potential to be used to create compounds for a wide variety of  indications. The ability to "plug and play" at the molecular level, made possible  by PNL's computational and nano-fabrication technology, opens the door to the deliberate design and development of entirely new types of pharmaceutical materials that could address indications across a vast and diverse number of pharmaceutical and  biotechnology market segments.

Phasiks Inc.

Phase II Award No.: 0848967
Phase IIB Award No.: 1155397

Award Amount: $812,730.00

Start Date: March 1, 2009
End Date: August 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Themally-Actuated Microfluidic Systems

This Small Business Innovation Research (SBIR) Phase II project will develop a new technology to satisfy the need for reliable and inexpensive ultifunctional fluid handling and control in microfluidic devices. Building on the Phase I results, which demonstrated the fundamental concepts of thermal actuation of microfluidics, the goals of the Phase II program are to demonstrate, develop, and optimize thermal actuation techniques for all useful microfluidic fluid handling functions, and to demonstrate the ability to combine the various functions into an integrated device. To achieve these goals, methods will be developed for fabricating, operating, evaluating, and optimizing devices demonstrating each function of interest in a realistic application setting. The end result will be a complete microfluidic tool box that can be applied to supply fluid handling and control functions to a variety of customers for implementation in commercial microfluidic devices.

The broader impacts of this research are in the areas of biomedical and biopharmaceutical research, and clinical diagnostics. Successful completion of this Phase II program would result in development of a set of thermally-actuated functional elements enabling a less complex and more cost-effective biomedical microfluidic device; the "lab-on-a-chip" system. The potential commercial value is significant. The increasing complexity of molecular diagnostic tests and the pressure to provide cost-effective, reliable, and repeatable point-of-care assays will continue to increase the demand for such systems. Societal impact of such a technology will include substantial cost reduction, more accurate and consistent results, and improved health care resulting from more rapid and specific treatment.

Phoenix Biosystems

Phase II Award No.: 1026459
Phase IIB Award No.:

Award Amount: $450,495.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Label Free Nucleic Acid Assays for POC Diagnostics

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a for point-of-care (POC) nucleic acid assay for STD (sexually transmitted diseases) diagnostics using Electrochemical Impedance Spectroscopy (EIS). Chlamydia trachomatis (CT) and Neisseria gonorrhoeae (GC) infections are two of the most common sexually transmitted diseases worldwide. The company proposes to develop a multiplex assay and testing platform for the direct detection of CT and GC rRNA using EIS-based assays and a sensor array. In a final product for clinical settings, collected sample (e.g., swab or urine) will be processed on-cartridge, with all cartridges provided in a sealed, RNase-free package.

The broader impact/commercial potential of this project will address the unmet market needs for a rapid and cost-effective nucleic acid based POC system to diagnose individuals with infectious disease-causing agents or toxins in nontraditional health care settings. Often persons who present to a clinic for STD testing never return to the clinic to receive their STD test result. Thus, the availability of a POC test that can immediately provide results at the clinic is highly desirable. Current POC tests lack sensitivity, which may lead to high false negative as well as false positive results. The company proposes to develop an inexpensive, highly sensitive, easy-to-use POC STD device to address this compelling market need. In addition, the EIS-based biosensor system could be adapted for the POC detection of other infectious diseases.

Physcient, Inc.

Phase II Award No.: 1026703
Phase IIB Award No.:

Award Amount: $499,986.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Detection and Prevention of Tissue Trauma During Surgical Retraction

This Small Business Innovation Research Phase II project will develop a hand-held controller for motor-powered surgical instruments. The controller will enable automated operation of the surgical instrument, including biomechanically informed algorithms, that decrease trauma to tissues during surgery. This controller will be first deployed on a new thoracic retractor, an instrument used to pry apart the rigid tissues of the chest to provide surgical access to organs inside the chest, e.g. the heart and lungs. Thoracic retractors are used in two common thoracic procedures for surgical access: (1) thoracotomy, in which an incision is made between the ribs and the thoracic retractor pries apart the ribs, and (2) sternotomy, in which the sternum is bisected and the thoracic retractor pries apart the two halves of the thoracic cage. Current thoracic retractors are simple mechanical jacks developed in the 1930's, and they severely traumatize the tissues of the chest by, for example, breaking ribs and tearing ligaments. The controller developed in this SBIR will enable automated retraction of the thoracic tissues, including an algorithm that can both detect that a fracture is about to occur and then avert that fracture, thereby greatly decreasing trauma to the thoracic tissues.

The broader impact/commercial potential of this project is both to improve patient's lives by decreasing the trauma of surgery (decreasing both post-surgical pain and complications) and to decrease the cost of health care by reducing the amount of medical care a patient needs after surgery (both decreasing the length of hospital stays after surgery and reducing the incidence of expensive complications). Nearly 600,000 people have a sternotomy or a thoracotomy each year in the US, and recovery from these procedures is frequently marked by significant post-operative respiratory dysfunction and pain. The new surgical instrument controller being developed in this project will improve post-surgical recovery for all of these patients. Importantly, this is the first application of biomechanically-informed algorithms to surgical retraction, and we anticipate their applicability to many more surgical procedures, generating both significant commercial opportunity and significant improvements in health care.

Plant Sensory Systems, LLC.

Phase II Award No.: 0923966
Phase IIB Award No.: 1144278

Award Amount: $840,999.00

Start Date: August 15, 2009
End Date: July 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: GABA-Mediated Nitrogen Efficiency

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project addresses the need for crops with increased yield. Yield is directly related to nitrogen (N) utilization and is dramatically affected by climate. Plant Sensory Systems has developed a genetic modification to plants that increases their N use efficiency (NUE) and tolerance to drought and high temperatures. The modification is the insertion of a novel pathway for making gamma-aminobutyric acid (GABA) in plants. Phase I research demonstrated that the genetically modified model plants were more drought- and heat tolerant and had higher yield in both N-limited and N-sufficient conditions compared to wildtype plants. In Phase II the gene construct will be tested in a crop plant to demonstrate commercial feasibility. Agronomic performance in N- and water-limited and sufficient conditions will be determined in homozygote corn lines.

The broader impacts of this research are the stabilization of the agronomic sector of the economy and a reduction in adverse effects of agriculture on the environment. The innovation would lead to crops with higher yields that cost less to produce. The need for less N fertilizer would reduce costs to the growers and have significant environmental savings by reducing the amount of N that runs into the watershed. Moreover, a reduction in fertilizer production and application would reduce greenhouse gas emissions. The innovation confers tolerance to climate changes, which would also reduce crop-production costs and increase yield. The proposed technology has great commercial potential in a market actively seeking increased NUE and value-added traits.

Prediction Sciences, LLC

Phase II Award No.: 0750452
Phase IIB Award No.: 1063214

Award Amount: $847,480.00

Start Date: June 1, 2008
End Date: November 30, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Multi-Marker Prognostic Test for Breast Cancer Outcome

This Small Bbusiness Innovation Research (SBIR) Phase II project aims to continue the validation of a set of markers for predicting recurrence and guiding the selection of treatment in stage I-III breast cancer patients. Upon removal of their primary stage I-III operable tumors, breast cancer patients must decide whether or not to receive adjuvant therapy such as chemotherapy, or hormone therapy. Currently, the physician and patient can arrive at the decision by relying on several published guidelines whose accuracy is limited by the fact that they are based on general clinicopathologic data such as tumor size and grade. Thus the majority of patients are recommended to receive adjuvant therapy, although only a small fraction of them benefit from it.

Availability of a set of reliable markers that can predict recurrence of tumors would allow tailoring of adjuvant therapy for each patient and is thus likely to reduce the chances of under-treatment and over-treatment. As such, it would be of great benefit to cancer patients, as well as to oncologists.

Real-Time Analyzers, Incorporated

Phase II Award No.: 0956170
Phase IIB Award No.: 1237521

Award Amount: $517,904.00

Start Date: April 1, 2010
End Date: June 30, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: A Label-Free Surface-enhanced Raman Spectroscopy-Capture Assay in Microchips for Biological Warfare Agents

This Small Business Innovation Research (SBIR) Phase II project will develop a prototype analyzer that can detect, identify, and quantify the presence of Category A (B and C) bioagents at the required specificity and sensitivity (e.g. in air 104 spores/m3, 100 organisms/m3 and 2-300 mg toxin/m3) within 10 minutes. The analyzers will incorporate a novel surface-enhanced Raman spectroscopy (SERS)-based assay into sample systems read by a portable Raman spectrometer. The assays will be functionalized to selectively capture specific bioagents and generate unique SER spectra when irradiated by the analyzer laser. During Phase I, feasibility was demonstrated by selectively binding and detecting 25 ppm B. cereus (a B. anthracis surrogate) in the presence of 250 ppm B. subtilis. During Phase II, the assays will be developed to detect several real agents, such as B. anthracis (anthrax), Yersinia pestis (Plague), Francisella tularensis (Tularemia), and Clostridium botulinum (Botulism). The assays will then be incorporated into a product prototype that autonomously detects aerosolized bioagents. The analytical capabilities of the prototype will be validated at the US Army's Edgewood Chemical Biological Center.

The broader/commercial impact of this project will provide a bioagent detector with the necessary sensitivity and speed to save lives and reduce substantially the terror associated with biological attacks. The continued presence of US military personnel in the Middle East has produced a persistent fear that biological warfare agents may be used by terrorists against civilian and military personnel at home and abroad. The proposed analyzer will allow measurement of such bioagents within 10 minutes, a vast improvement over the 2-3 hours required by current technology. Initially, the proposed detector will be used to protect military bases. Once established, the application of this product will be expanded to civilian applications, such as transit systems, high profile buildings (federal, financial, Fortune 500), stadiums, airports, and malls. The US military and civilian market is currently estimated at $0.5 Billion.

Redwood Bioscience Inc

Phase II Award No.: 1151234

Award Amount: $461,368.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Biological and Medical Technologies

SBIR Phase II: Design And Production Of IgG Fc Carrier Scaffolds With Increased Payload Capacity

This Small Business Innovation Research (SBIR) II project outlines in vivo testing of semi-synthetic therapeutic protein conjugates. Low molecular weight peptide drugs have had limited therapeutic utility due to rapid clearance and, consequently must be injected very frequently. These drugs could be conjugated to a carrier protein. Attachment to large biomolecules, such as carrier proteins, improves the half-life profile of these peptides. Historically, many of these carrier proteins are recombinant genetic fusions with the peptide of interest. With fusion, the carrier's attachment to the peptide is limited to one site, the end terminus, and that limited placement can impact drug function and thus potency. As an alternative, chemical modification to carrier proteins with small molecule drugs can also render the drug more potent and longer lasting. The scientists at Redwood Bioscience have developed a technology platform that can universally modify proteins in a controlled, site-specific manner. They have generated carrier protein scaffolds, modified recombinant Fc domains that are homogeneous and easy to chemically elaborate with therapeutic peptides. Furthermore, optimized peptide conjugation to the Fc proteins improves conjugate activity in vitro. This technology is to be further validated through an initial in vivo analysis.

The broader impacts of this research are the development of best in class therapeutics and the generation of a robust protein modification platform. This work will change the utility of protein therapeutics by enabling optimization of therapeutic peptides that otherwise would not be useful as treatment for disease.

Sarentis Ophthalmics, Inc.

Phase II Award No.: 1152561

Award Amount: $449,696.00

Start Date: April 15, 2012
End Date: March 30, 2014

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Regenerating Ocular Surface Wounds with Novel Biomaterial

This Small Business Innovation Research (SBIR) Phase II project will result in a bandage that accelerates wound healing to the surface of the eye. Eye wounds are extremely painful, can cause vision loss, and may fail to heal on their own. Trauma may occur due to household cleaning agents, traumatic impact from a falling object, or removal of a contact lens. Ocular surgeries, such as cataract and refractive surgeries, are also sources for corneal injury. Delays in healing may lead to scarring and permanent visual loss. This project will lead to the first biodegradable "green" corneal bandage that accelerates corneal healing. The bandage resembles a contact lens. When this bandage is placed on a wounded eye it reduces inflammation and stimulates the healing process. It is made of a novel biomaterial, which can be programmed to "dissolve" within hours to days providing patients with a tailored product. Completed work from Phase I demonstrated the corneal bandage significantly accelerated corneal healing rate. During Phase II further development will ready the product for human clinical trials. Results from Phase II will produce the final product design, quality system implementation, and initial development of a GMP manufacturing process.

The broader impact/commercial potential of this project will help the 2 million Americans that sustain traumatic injuries to the cornea each year, and the 4 million Americans that undergo surgery annually leaving the cornea wounded. Such corneal wounds cause intense pain and may lead to blindness depending on the severity. This new eye bandage accelerates corneal healing and adheres to the surface of the eye to aid in alleviating pain. The bandage is inexpensive and will result in a less expensive procedure for treating cornea trauma resulting in millions in savings to the American health care system, while allowing for the expansion of the point of care environments (i.e. clinic, home use, hostile environments). Production is fully scalable to large quantities, and can be easily packaged and distributed in a similar fashion as a contact lens. Furthermore, the eye bandage is an innovative technology, patented, and new to the medical device industry.

Semprus Bioscience Corporation

Phase II Award No.: 0822959
Phase IIB Award No.: 1047700

Award Amount: $999,923.00

Start Date: August 15, 2008
End Date: July 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Permanent Attachment of Antimicrobial Peptides to Central Venous Catheters.

This SBIR Phase II project continues SteriCoat's development of a permanent antimicrobial coating for use on central venous catheters. Current leaching antimicrobial technology does not possess the duration of efficacy required to protect these devices over the lifetime of implantation, especially for peripherally inserted central lines (PICCs). Research during this Phase II project will focus on the integration of proprietary polymer technology with tethered antimicrobial peptide (AmP) technology developed in Phase I to maximize the efficacy and bioavailability of the immobilized AmPs in vivo. Work will also be performed to ensure the manufacturability of SteriCoat's coating technology, including prototype production. After transitioning this formulation to the intra- and extraluminal surfaces of a polyurethane tube, efficacy and biocompatibility will be demonstrated both in vitro and in vivo. By the end of this Phase II project, SteriCoat will have an antimicrobial CVC model with efficacy proven in vivo using the models designed by industry thought leaders and will be ready for scale-up and manufacturing.

This SBIR Phase II project addresses the hospital infections afflicting 1.7 million patients and killing 99,000 in the US annually, the majority of which are associated with medical devices. Existing slow-release antimicrobial coatings are insufficient in addressing device infection. They have a limited lifespan and concerns over drug resistance and toxicity because the drug gets distributed in the bloodstream. SteriCoat is developing a permanent coating using antimicrobial peptides (AmPs) to prevent bacterial colonization of central venous catheters (CVCs), a $350M market. The goal of this project is to deliver a polyurethane-based antimicrobial CVC model which incorporates a surface functionalization with AmPs and to test the ability of this approach in resisting bacterial colonization. By the end of this phase II project, SteriCoat will have verified in vivo efficacy of prototype catheters and be positioned to begin GLP studies for FDA product approval. In addition, achievement of the technical objectives of this Phase II will open up avenues for additional investigation in the field of bioactive ligand presentation as the developed technology could lend to the efficacy of many biomaterial applications in addition to antimicrobials.

Stellar Biotechnologies, Inc.

Phase II Award No.: 0848952
Phase IIB Award No.: 1147629

Award Amount: $1,059,224.00

Start Date: March 15, 2009
End Date: August 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Megathura Crenulata Post Larval Culture - Bottleneck for a Valuable Medical Resource

This Small Business Innovation Research (SBIR) Phase II project will develop methods for the control of larval settlement, metamorphosis and postlarval growth of Megathura crenulata (keyhole limpet) to support the production of commercial quantities of Keyhole Limpet Hemocyanin (KLH), a unique and medically valuable marine natural product. Unlike many other prospective medical products from marine organisms, KLH is already in extensive use in over 20 KLH-based therapeutic vaccine trials. Phase I research successfully identified a critical "cue" for settlement of M. crenulata larvae and demonstrated the feasibility of achieving the long-term commercial objectives of this research. Phase II studies will translate the results from Phase I studies into prototype designs for testing and optimization of systems, diets and aquaculture methods for cultivation of the age-specific developmental phases, from metamorphosis to fully developed adults for KLH production.

The broader impacts of this research are; 1) The elucidation of the underlying biochemical factors that promote settlement, metamorphosis and early postlarval survival of this carnivorous gastropod thus adding significantly to the body of scientific knowledge in this field and improving the potential for cultivation of other commercially important species with biomedical potential; 2) Providing sustainable commercial supplies of KLH for new, life-saving therapeutic vaccines for cancer, arthritis, hypertension, and other debilitating diseases, without continued dependence on the limited and threatened fishery, and; 3) Providing regulators and resource managers the opportunity to formulate management policies to protect the wild population without imposing limitations on KLH or the important KLH-based vaccines under development.

Stemina Biomarker Discovery, inc.

Phase II Award No.: 1058355

Award Amount: $500,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Metabolomics of Human Embryonic Stem Cells to Predict Teratogenicity: An Alternative Developmental Toxicity Model

This Small Business Innovation Research (SBIR) Phase II project will fund a continuation of breakthrough research, development and commercialization of an in vitro assay to help prevent birth defects. This innovative product is driven by a need to create a test for human developmental toxicity that is more accurate than current tests that use animals. False negative results from these animal assays have lead to unexpected cases of birth defects, such as observed with Thalidomide. This assay, performed on human embryonic stem cells, is more predictive of developmental toxicity than animal models (80% vs 60%) and unlike animal models, provides data about specific human biochemical pathways that are affected. This will fund research to 1) identify biomarkers of developmental toxicity present in three different human cell lines, 2) optimize automation systems, 3) create a web-based interface to be used by customers, 4) standardize and create quality control procedures and 5) take the initial steps required for validation of the assay by the European Centre for the Validation of Alternative Methods (ECVAM). Upon validation, the test will be required in Europe for assessing developmental toxicity of newly developed pharmaceuticals and may be further used for testing of environmental chemicals as well.

The broader impacts of this research include 1) a global reduction in drug and chemical induced human birth defects 2) significant cost savings (up to $70 million per drug) for pharmaceutical companies allowing greater confidence in drug candidate selection and 3) a major global reduction in animal testing.

Stratatech Corporation

Phase II Award No.: 1058591

Award Amount: $499,877.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: An Innovative Full-Thickness Human Skin Model for Increased Throughput Screening in Drug Discovery

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a high-throughput assay incorporating 3-D skin models capable of accurately identifying and characterizing DNA damage. There is an urgent need for improved genotoxicity assays for safety screening in drug development. The process by which drug compounds are usually screened is expensive, time-consuming, and often does not provide an accurate depiction of in vivo behavior. Phase I of this project developed a full-thickness skin model that can be used in a range of toxicological assays. Phase II will address the limitations of current genotoxicity assays by incorporating fluorescent reporter constructs into the 96-well skin model to create an assay that is high-throughput and accurately distinguishes between classes of genotoxins.

The broader impacts of this research are to develop a genotoxicity screen that is more informative, accurate, and high-throughput than existing alternatives. Development of accurate in vitro assays not only reduces the need for animal testing, but can also reduce the risk to patients included in clinical trials by providing better predictions of the human response. Toxicity has become one of the leading reasons for product failure during drug development. The ability for this assay to identify and eliminate harmful compounds earlier in the development process could significantly reduce the costs and accelerate the timeline of drug development. In addition to these direct contributions for drug and chemical screening, the mechanistic data provided by this assay will provide a valuable tool for basic science research into DNA damage.

Streamline Automation, LLC

Phase II Award No.: 1026265

Award Amount: $515,853.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Particle Filtering Technology for Wearable Medical Sensors

This Small Business Innovation Research Phase II project will develop an enhanced pulse oximeter prototype ready for external demonstration. The key innovation of the prototype will be the Intelligent Data Extraction Algorithm (IDEA), which during Phase I demonstrated extraction of embedded hemodynamic information from photoplethysmograms, including left-ventricular stroke volume and cardiac output. IDEA will evolve in sophistication to increase diagnostic range and accuracy. Both extended evaluation and preliminary clinical validation studies will take place in order to assess the reliability of measured hemodynamic values and trends. Close interaction with doctors will help define clinical uses for this new technology. If successful, the final prototype will enable the noninvasive measurement of valuable hemodynamics with associated error bars (confidence intervals) including stroke volume and cardiac output. Other features include resistance to strong motion artifacts, continuous and real-time operation, and utilization of existing sensor hardware.

The broader impact/commercial potential of this project is to solve noninvasive measurement of valuable hemodynamics that cannot be met with current technology. During anesthesia, surgery, and recovery, our IDEA-enhanced pulse oximeter can track the patient's hemodynamic evolution throughout, warning against possible adverse reactions or 'silent hemorrhages' that do not show up in any standard monitoring equipment. In the neonatal ward, it can monitor babies born with congenital heart disease or poor blood flow. At home, it can be used to monitor patients with chronic heart conditions (the top killer in the US) and warn doctors about developing acute problems such as arrhythmias and heart attacks. In the battlefield and disaster areas, our device can dramatically improve the speed and accuracy of triage to save the lives of injured soldiers and victims. Many other medical practices would benefit from the use of noninvasive and continuous stroke volume and other hemodynamic monitoring to expand the amount of vital information available at the patient care area and eliminate the need for risky invasive procedures.

SyntheZyme LLC

Phase II Award No.: 1058511

Award Amount: $491,766.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: Advanced Biopesticides from Yeast Produced Sophorolipids and Modified Analogs

This Small Business Innovation Research (SBIR) Phase II project will address further development of findings from the Phase I Project addressing development of advanced biopesticides by simple and scalable modification of sophorolipids. The yeast Candida bombicola produces sophorolipids (SLs) in volumetric yields of ~ 300 g/L. The Phase I program demonstrated that by simple chemical modification of unrefined natural SLs, a series of five highly active lead compounds were identified which possess broad spectrum activity against all three major fungal groups that cause serious diseases in commercially important plants. By amidation of the SL fatty acid carboxyl group (e.g. - NH2CH2CH2N(CH3)2), or by reduction of the SL-fatty acid double bond, derivative activity against pathogens greatly increased. Minimum inhibitory concentration (MIC) values of amide SL-derivatives were generally on a par with tested commercial fungicides.

The broader impacts of this research address the market pull for green agricultural products by developing a bio-pesticide produced via an efficient microbial fermentation followed by simple chemical modification to improve the performance of nature's molecules. The goal is to create a superior bio-pesticide product that does not harm the environment, is safe for farmers that regularly handle these materials, and to provide safe food for consumers. SyntheZyme bio-pesticides will contribute to the on-going green food-production revolution. Their introduction into the market is expected to replace an increasing fraction of synthetic chemical pesticides during season-long disease control programs. Furthermore, new safe bio-pesticides are needed to replace chemical pesticides now banned due to tightened regulations and increased concerns about their pollution and health hazards.

Syzygy Memory Plastics

Phase II Award No.: 1026135

Award Amount: $515,994.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Biological and Medical Technologies

SBIR Phase II: Injection-molded Thermoset Shape-memory Polymers with Enhanced Acoustic Properties

This Small Business Innovation Research (SBIR) Phase II project supports the development of a unique manufacturing method to produce novel shape memory polymers in complex shapes. These smart materials can "remember" and reform to a set shape upon an external stimulus. This continuous manufacturing process is vastly more efficient than the current state-of-the-art methods, enabling many low cost applications of shape memory polymers. This project will develop shape memory polymer earplugs that are heat activated by the user's ear and continuously adapt and self-adjust to custom fit any size ear canal. Current material solutions for earplugs suffer from several drawbacks, including an inability to control the force exerted by the earplug upon sensitive inner ear regions that cause pain over time. This effort will address the technical challenges of scaling up the low cost manufacturing process and establish formulations that will enable optimization of its acoustic performance. Human subject testing will be conducted to subjectively validate comfort and objectively validate attenuation with very differently sized ear canals. If successful, this project will yield a device with optimized acoustic properties and comfort ready for first commercial sale.

The broader/commercial impact of this project is the impact of a mass-manufactured shape memory polymer device. Due to their desired properties, shape memory polymers are increasingly used in biomedical applications, but their broader adoption into mass markets has been limited by cost and geometry constraints. If successful, this project will establish a novel manufacturing process that, through modified traditional plastics processing techniques, can mass manufacture a new class of polymers. Thus, the broad impact of this project is twofold: it will establish the first links between sound attenuation and crosslinker density in shape memory polymer earpieces, and it will lay the groundwork for future low cost shape memory devices of complex geometries. Better occlusion and more comfortable earplugs are expected to enable higher usage of protective hearing devices in loud industrial settings. This in turn addresses the growing problem of noise-induced hearing loss in the industrial sector, which according to OSHA, is the number one occupational disease in the US today. In addition, shape memory earplugs may benefit other users including musicians, professional athletes and children with autism. This technology can also be adapted to similar devices including cell phone headsets, Bluetooth audio devices, and hearing aids.

Thule Group of Consultants Inc

Phase II Award No.: 1127180

Award Amount: $498,884.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Sector: Biological and Medical Technologies

SBIR Phase II: On-Farm Algae Production for Livestock Feed and Biofuel

This Small Business Innovation Research (SBIR) Phase II project plans to refine and test prototype facilities for commercialization of on-farm algae production and harvesting. Algae will be utilized initially for livestock feed and in future for bio-fuel. The project targets an emerging global market for construction of on-farm algae infrastructure. At the consumer level, the market is driven by favorable consumer response to Omega-3 health benefits in meat, milk, cheese and eggs.

The broader impacts of this research are: to increase scientific and technical knowledge of algae production for animal feed; to grow, harvest and utilize algae strains that might otherwise be overlooked; to improve consumer health, especially cardio-vascular health, and reduce obesity; to meet the demand for algae in livestock feed; and to construct algae facilities which will be able to expand into bio-fuel production when oil extraction technologies mature. On-farm algae production conserves energy and protects the environment by using less water, fuel, and fertilizer than land-based farming.

Virogenomics, Inc.

Phase II Award No.: 1152483

Award Amount: $489,496.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Biological and Medical Technologies

SBIR Phase II: Electronic Allergy Diagnostics: Photo-Immobilization as a General Strategy for Attaching Structurally and Compositionally Diverse Ligands onto a Single Support

This Small Business Innovation Research (SBIR) Phase II project aims to create better diagnostic testing for drug, food, and environmental allergies. If successful, it would be transformative in the clinical diagnosis of allergy diseases by enabling rapid evaluation at the doctor's office in a format that is significantly preferable to skin-prick or challenge testing.

The broader impacts of this research are the development of next generation diagnostic devices. These devices will enable the diagnosis of many different conditions and diseases with just a small drop of blood, right in a doctor's office. Disease diagnosis from blood often requires that the blood sample, typically one or more test tubes full of blood, be taken from a vein in a patient's arm and sent to a clinical laboratory. This is uncomfortable for the patient, requires them to wait days for results, is expensive, and is less safe than the approach being developed by Virogenomics because a large amount of blood that must be transported and handled. The Virogenomics platform will use just a drop of blood and will provide results while the patient is still in the doctor's office. This diagnostic test works similar to the blood-glucose monitors diabetics use to monitor their blood sugar but is much more flexible in regards to the types of tests that can be done. In addition to allergy diagnosis, the proposed diagnostic platform would have application in many other fields that affect our health, such as diagnostics for autoimmune diseases, infectious disease and cancer.

Warwick Mills Inc

Phase II Award No.: 1152668

Award Amount: $499,480.00

Start Date: April 15, 2012
End Date: March 31, 2014

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Program Director: Ruth M. Shuman

Sector: Biological and Medical Technologies

SBIR Phase II: Rapid Self-Decontaminating Textiles

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a stretchy, disposable, textile glove intended to prevent cross-contamination with 3-log reduction against bio-pathogens in under 90 seconds. Its chlorine coating lasts for three days and unlike nitrile, latex, and vinyl gloves, is breathable, reducing dermatitis associated with continual barrier glove use. Currently antiseptic test standards for textiles, hand wash and hand rubs, AATCC TM-100, BS EN 1499 and EN 1500 are inadequate to accurately evaluate project's goal of 3-log reduction in 30-90 seconds. We developed a new protocol appropriate to these faster times and that specifically measures contact transfer - the Contact Transfer Test Protocol - that measures cross-contaminating efficacy in seconds. This new protocol can be used in the evaluation of other biocidal systems aiming for short pathogen kill speeds.

The broader impact/commercial potential of this project, if successful, is an innovation in the field of cross-contamination control. While other attempts to make a self-decontaminating fabric have been made, their 3-log kill times are much longer than the 30-90 second goal of the BioTecT Glove. The new BioTecT Glove represents a significant contribution to the field of pathogen control, such as Vancomycin-resistant Staphylococcus Aureus (VRSA) and Methicillin-resistant staphylococcus Aureus (MRSA) that persist even where strong hand antiseptic and barrier glove programs are in place. While the largest demand for the introduction of an innovative solution intended to decrease the number of facility acquired infections (FAIs) may be in the healthcare field, many other markets such as hospitality facilities, the janitorial field, and correctional institutions can also benefit greatly from this technology. From a financial perspective, the cost of an infectious outbreak to a healthcare facility can be catastrophic. Moreover, the socio-political consequences and the impact on a facility's reputation can create long-term negative impressions that may remain in the public's conscience for extended periods of time. As a rapid, self-decontaminating garment, the BioTecT Glove provides an active, innovative solution to this common and serious problem in an affordable, easy-to-use, and effective manner.

X-Ray Optical Systems, Inc.

Phase II Award No.: 1026559

Award Amount: $515,898.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Jesus Soriano

Sector: Biological and Medical Technologies

SBIR Phase II: Quantitative Analysis for Trace Levels of Toxic Elements in Consumer Products Using High Definition X-ray Fluorescence

This Small Business Innovation Research (SBIR) Phase II project will demonstrate rapid, nondestructive, quantitative analysis of trace-level toxic elements in both substrates and coated layers for consumer products in a device fit for purpose on a factory floor. Restrictions such as the Consumer Product Safety Improvement Act of 2008 (CPSIA) are expanding world wide beyond lead to include additional harmful elements at trace levels. The analyzer will provide manufacturers the means to conveniently test their products, raw materials, and components for compliance with the new standards. Currently, there is no practical method to accurately test outside of a lab. The objective is to construct an analyzer for quantifying ten toxic elements at or below regulated levels. The analyzer will use XOS's world-leading x-ray optics to produce multiple monochromatic beams from a single x-ray tube, providing excellent sensitivity, lower limits of detection, and short measurement times for the entire relevant part of the periodic table. It will include advanced software for processing the combined data sets and separating the results for the coatings and substrates. The low-power consumption, reduced maintenance, and compact design are fit for purpose in manufacturing, distribution, or regulatory environments.

The broader impact of this research is the mitigation of inadvertent exposure risk. Toys and other consumer products will be safer as adults and children are protected from toxic elements. American manufacturers, distributors, retailers, and regulators are facing increasing global regulations restricting hazardous substances in manufactured products with associated costs and liability risks. This new testing capability would reduce testing costs by more than 75%, currently more than $1B, compared to existing laboratory-based methods. It would also assist U.S. manufacturers and distributors in cost-effective compliance by testing before the products leave the plant or distribution center, thereby, gaining or preserving their competitive position and avoiding the loss of sales and jobs due to offshore migration of manufacturing. This analyzer will also enable manufactures to safely explore new materials as a substitute for restricted materials. Consumer fears provide U.S. manufacturers an opportunity to increase market share if they can demonstrate safety. Additionally, the societal benefits for consumers are significant. Consumers can be certain the products they buy are safe. The ability to accurately detect toxic elements will help to reduce their proliferation into the marketplace and improve public health. This enables improved quality of life and a reduced health care burden.

ATRP Solutions, Inc.

Phase II Award No.: 1026575

Award Amount: $520,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Adapting ATRP to Industrial Scale Production

This SBIR Phase II project will scale up the atom transfer radical polymerization (ATRP) synthetic method to a 200 L scale from a 1 L scale that was developed in the Phase I work. This ATRP synthetic process is a highly controlled method for synthesizing polymers and copolymers specifically with highly tailored architectures including molecular structure and molecular weight distribution which can affect the properties of the material significantly.

The broader impact/commercial potential of the project will be to create a commercially viable option for producing specialty polymers that might not otherwise be feasible to produce on a large scale. This SBIR Phase II project will allow straightforward scale-up of ATRP process and bring it much closer to the broad market of commercial products. More importantly, the successful validation of the new 'feeding' method for ATRP will allow, in the near future, a significant decrease in the consumption of energy and generation of chemical waste for all companies, which will utilize the ATRP technology for the synthesis of new well-defined and better performing materials.

Boulder Ionics Corporation

Phase II Award No.: 1152040

Award Amount: $499,980.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Chemical Technologies

SBIR Phase II: Novel synthesis method for ionic liquids

This Small Business Innovation Research Phase II project is targeted at the development of a novel, low-cost continuous method for the production of ionic liquids. Ionic liquids are a class of industrial chemicals with broad applications in energy, pharmaceutical, biomass and solar fields. Ionic liquids are leading candidates for electrolytes in advanced batteries and capacitors where they enable non-flammable, longer-lived batteries that store more energy than current models. While the potential of ionic liquids is significant, the current cost is prohibitive. Boulder Ionics Corporation proposes to develop a novel, cost-effective method for producing ionic liquids in industrial volumes. The highly flexible technique enables continuous production of ionic liquids with low capital cost. It eliminates the use of solvents in the synthesis process, and produces a very high purity product. In Phase II the company will develop the novel synthesis process, demonstrate low-cost ways of making key precursors, and develop techniques for purifying and measuring the purity of the products. Successful completion of the program will result in low-cost, high-performance electrolytes for advanced energy storage.

The broader impact/commercial potential of this project is to make ionic liquids cost-effective in a wide range of industries. Ionic liquids can replace volatile organic solvents in a vast range of industrial processes, are leading candidates for biomass processing, and have broad applications in electrochemistry, advanced batteries, supercapacitors/ultracapacitors and as heat transfer fluids in advanced concentrating solar plants. In addition, our innovative synthesis technique has broad application across the chemical industry. Cost-effective ionic liquids are critical elements of the new energy economy, with applications in biomass, solar power, and grid-scale energy storage. Techniques developed in this research will enhance scientific understanding of novel chemical reactors, leading to a new generation of more efficient and less-polluting chemical plants. Knowledge gained in this program will enable technologies that will enhance U.S. energy security, and strengthen the emerging U.S. battery industry.

Cerahelix, Inc.

Phase II Award No.: 0956899

Award Amount: $601,574.00

Start Date: April 1, 2010
End Date: June 30, 2012

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Sector: Chemical Technologies

SBIR Phase II: Highly Ordered Membranes for Molecular Separation

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a ceramic nanofiltration membrane with highly uniform pores oriented perpendicularly to the membrane surface using DNA as a template in a silica sol-gel. This membrane will be optimized to perform molecular separation and purification of fuels and chemicals from cellulosic biomass. The research objectives are to create a membrane with the desired pore size and orientation features. A prototype membrane will be produced and tested for its ability to dewater biofuels by pervaporation. It is anticipated that the selective ceramic membrane layer will provide efficient separations and have high temperature and chemical tolerance. The membrane will have applications for a range of industrial markets including wastewater purification and desalination.

The broader impact/commercial potential of this project is the development of an innovative membrane technology that will contribute significant energy savings to the production of alternative fuels from cellulosic biomass. Potential end users will include biorefineries that convert cellulosic biomass to fuels and chemicals. A great advantage of molecular separations by membranes rather than distillation is the 40- 50% savings in energy. If successful, this project would lead to a new class of high-throughput ceramic nanofiltration membranes that will have applications to other industrial sectors, including wastewater purification, natural gas purification, and coal gasification. This project promises to contribute significant energy savings to the production of alternative fuels from renewable resources.

Endres Machining Innovations

Phase II Award No.: 1026686

Award Amount: $500,333.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Cost- and Energy-Efficient Conversion of Cellulosic Biomass to Bio-Fuel Feedstock of Consistent and Preferred Geometry

This SBIR Phase II project will develop and commercialize a new energy efficient long-lifed cutting attachment for chipping cellulosic biomass into bio-fuel feedstock while achieving reduced specific energy, significantly longer knife-change intervals, and controllably-fine chips needed by various bio-fuel applications. The innovation involves an adaptation of advanced metal-cutting technology to replace traditional chipper knives.

The broader impact/commercial potential of the project will derive from creating technology to use inexpensive and readily accessible local feedstock for the production of bio-fuels, reducing the cost of feedstock processing upstream of enzymatic hydrolysis. Energy independence and sustainability along with environmental issues strongly motivate the inclusion of biomass to diversify the national and global energy portfolios. Cellulosic bio-fuels applications are poised to grow, but exhibit technical and economic challenges, one of which relates to the need for finer feedstock particles and the inefficiencies of increased chipping energy and knife wear that come with finer chipping.

Faraday Technology, Inc.

Phase II Award No.: 1058465

Award Amount: $590,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Electroconcentration, Separation, and Rupture of Bioalgae for Fuel Production

This Small Business Innovation Research (SBIR) Phase II project addresses the need for innovative approaches to harvesting oil from bio-algae, specifically to dewater the bio-algae and recycle the processed algae stream for reuse. The subject innovation will facilitate the development of an economical alternative to current technologies, and result in a more favorable application of bio-fuels to the marketplace. Current dewatering technologies (e.g., centrifugation and chemical flocculation) are energy intensive and require chemical additives that can contaminate the oil, resulting in prohibitively high costs to concentrate bio-algae for fuel production. The Phase II program objective is to develop, scale up and integrate the FARADAYIC ElectroConcentration and ElectroFlotation Processes with Harvesting, Dewatering and Drying (HDD) technology being developed by our strategic partner, Algaeventure Systems (AVS), to quickly and efficiently dewater bio-algae.

The broader impacts of this research are in the energy and cost savings that will result from the innovative dewatering process. This technology will enable a cost effective, energy efficient, nearly carbon-neutral source of bio-fuel that does not compete with food crops. Bio-fuel technology is anticipated to have a significant environmental impact by greatly reducing carbon dioxide emissions (e.g. from power plants) by storing the carbon dioxide as lipids. This technology would find applicability in other areas of the algae cultivation industry (bio-plastics, dyes, pharmaceuticals, etc.) and also result in an improved understanding of electric field effects on algae concentration processes. Finally, this project provides opportunities for teachers and undergraduates to gain research experience through the NSF RET/REU programs.

Hans Tech

Phase II Award No.: 1058494

Award Amount: $536,000.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: USV-Grain Refining

This Small Business Innovation Research (SBIR) Phase II project proposes to combine the latest technologies in processing of lightweight materials using ultrasonic vibration(USV), in mold cooling, and in continuous casting, and to develop an enabling USV‐GRTM technology for producing metal ingots of ultrafine grains without the use of foreign particles for grain refining. Our Phase I results indicate that the new USV‐GRTM technology is feasible in producing metal and alloy products with grain size much smaller than that obtainable using the bst commercial grain refiners. It is expected that the new technology will lead to an increased productivity; reduced defect formation associated with the use of grain refiners containing foreign particles, and improved internal quality of the metal and alloy products.

The broader impacts of this research are in the areas of increasing the use of lightweight metals and alloys for applications i the aerospace, defense, automotive, and metalcasting industries for significant cost savings, energy savings. The implementation of the research results will lead to a breakthrough technology for grain refining of a vast array of metalsand alloys to improve the mechanical and physical properties, particularly ductility and electrical conductivity. The new technology can also impact the efficiency in power transmission since most of the power cables are made of pure aluminm metal that are grain refined using chemical grain refiners. In addition, students involved in the research will have opportunities to interact with industrial partners.

KTM Industries

Phase II Award No.: 1027419

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

STTR Phase II: Designing and Engineering Thermoplastic Starch BioFoam Materials for Protective Packaging Applications

This Small Business Technology Transfer (STTR) Phase II project targets the design and engineering of biodegradable starch biofoam materials for protective cushion packaging and thermal insulation (coolers) market. These new biobased foam materials are expected to displace petro/fossil-based materials used currently in these applications. Previous feasibility demonstration has: (a) established the manufacturability of modified starch biofoams with good moisture resistance, strength, resilience and surface uniformity; and (b) validated the applicability of these biofoam materials in the protective cushion packaging and thermal insulation (coolers) market sectors by major industrial users. The Phase II project will build on these successes and develop robust and cost-effective manufacturing and optimized formulations for broader and greater penetration of the $2.6 billion foam packaging market. The technical advancements implied in this research are expected to significantly accelerate the development of a broader range of bio-plastic products based on bio/renewable feedstocks for successful commercial deployment.

The broader/commercial impact of this project is that it addresses the growing pressures on companies and countries to reduce their carbon footprint, and provide for environmentally responsible and efficacious end-of-life options. The U.S. Government's BioPreferred program identifies biobased, biodegradable foams with minimum 50% biobased content as one of the targeted items for federal procurement. Current foam plastic packaging, based on petro/fossil feedstocks, presents a major disposal problem, as it is lightweight and bulky and so does not lend itself to a viable economic and environmentally responsible recycling operation. It is also not biodegradable, which makes disposal in soil or composting operations untenable. If successful, this project will offer a sustainable, material carbon footprint neutral alternative. The new starch foam products will have the performance of current synthetic plastic foam but can be safely, completely, and efficiently biodegraded in soil or composting operations. These new products will fit both private sector market needs and federal government initiatives.

Membrane Technology & Research, Inc.

Phase II Award No.: 1127395

Award Amount: $500,000.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Carbon-Ceramic Composite Membranes for Olefin-Paraffin Separations

This Small Business Innovation Research Phase II project proposes to continue the development of carbon-ceramic membranes with excellent propylene/propane separation performance. The membranes serve as the enabling technology to be used in an environmentally benign and economically viable membrane process to separate propylene from propane for a variety of important petrochemical and refining processes. These composite membranes contain thin selective layers of a newly-developed microporous carbon material. The rigid structure of the material confers the membranes with exceptional resistance to plasticization. This allows the membranes to retain high mixed-gas selectivities at challenging industrial conditions. The mixed-gas propylene/propane selectivities and stability of the membranes achieved in Phase I work are far superior to those of previously examined polymer and facilitated transport membranes under industrially relevant conditions. In Phase II work, membranes developed in Phase I will be further optimized, and then used to produce prototype commercial-size modules for propylene/propane separations. In addition, this research is expected to increase general understanding of carbon-ceramic membranes and their potential for use in an array of other chemically and thermally challenging gas separations that are not possible with conventional polymeric membranes.

The broader impact/commercial potential of this project will be the use of the new carbon membranes for propylene recovery from polypropylene and propylene derivative reactor purge streams. This technology has important economic potential, considering the large volumes of propylene, polypropylene and other propylene derivatives produced annually in the petrochemical industry. With successful development and demonstration of the membrane-based processes, their potentially much larger applications include propylene/propane separations for monomer production at steam crackers and recovery of propylene from fluid catalytic cracker off-gases in refineries. The cost of making ceramic membranes is higher than that of polymeric membranes, but the savings from lower process energy requirements will easily outweigh the increased membrane costs. If successful, the new membranes will make membrane-based olefin/paraffin separations technically and economically attractive for use in conjunction with, or in place of, distillation.

Metal Oxygen Separation Technologies, Inc.

Phase II Award No.: 1026639

Award Amount: $471,968.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Low-Cost Low-Impact Magnesium Production by Solid Oxide Membrane Electrolysis

This Small Business Innovation Research (SBIR) Phase II project aims to develop a new method for primary production of magnesium from its oxide ore using Solid Oxide Membrane Electrolysis. Unlike other primary metal processes, this approach emits no direct CO2, has no chlorine, and is fully continuous and automated. Published third party cost modeling has indicated that its costs are lower than all existing and proposed new processes. Building on an earlier feasibility demonstration using experiments and mathematical and cost modeling to show that the approach can produce oxygen as well as magnesium at high current efficiency and at costs close to the published cost model, this Phase II project will develop new anode tubes to further reduce energy costs, and build and test the first self-heating electrolysis cell. If successful, the self-heating cell will not require energy beyond that needed for electrolysis and will be the smallest possible pre-production modular unit capable of producing magnesium.

The broader/commercial impact of this project begins with substantial reduction of the cost and environmental impact of magnesium metal production. Magnesium is the lowest-density engineering metal and third most abundant metal in the earth's crust, and its stiffness-to-weight, castability, and recyclability make it the best material for motor vehicle weight reduction. Automobile makers are seeking to increase the magnesium alloy content of vehicles from 10-15 lbs/vehicle to 350 lbs/vehicle by 2020, replacing 650 lbs/vehicle of steel and aluminum parts. This will increase fleet fuel economy by 1.5-2 miles per gallon, reducing annual petroleum import expenditures by about $20 billion. If successful, this project will address the biggest barrier to widespread magnesium use in vehicles, which is its price stability and availability. This could lead to a new magnesium economy taking full advantage of its light weight and ease of manufacturing in products from cellphones to laptops to trucks. With broader usage, the versatile process resulting from this development project can likely reduce the cost and environmental impact of reducing metal oxides, leading to a new industrial ecology of primary metals production.

Micro Magnetics Inc.

Phase II Award No.: 0924685
Phase IIB Award No.: 1145559

Award Amount: $772,000.00

Start Date: August 1, 2009
End Date: January 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Ultrafast spintronic devices based on magnetic tunnel junctions using magnesium oxide (MgO) tunnel barriers

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research Phase II project will develop an ultrafast solid-state magnetic sensor using MgO-based magnetic tunneling junction (MTJ). The operating frequency range will span from DC to 2 GHz, the broadest among competing technologies. The sensor will have a compact size and high sensitivity and will operate at ambient conditions with no supporting system. The ability to mass produce these devices will provide a significant cost advantage.

There is a critical unmet need in ultrafast sensors. These sensors can perform non-destructive evaluation (NDE) of VLSI semiconductor chips, aircraft components and engine turbines, they will allow computers to process information faster in data storage devices, and they can be used to measure fast currents in devices such as antenna. The sensors hold great promise for monitoring the health of aircrafts. Ultrafast sensors can also monitor the performance of VLSI in failure analysis, enhancing the competitiveness of the semiconductor industry by shortening the development cycles. Knowledge gained in ultrafast sensor can be used to make faster data storage devices and build better national defense infrastructure.

MIOX Corporation

Phase II Award No.: 1058239

Award Amount: $491,746.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Investigation of the Use of Chlorine Based Oxidants for Removal of Natural Organic Matter Using Advanced Oxidation Processes

This Small Business Innovation Research (SBIR) Phase II project will build on the successful results obtained during Phase I. Phase I research indicated that aqueous chlorine can be used as an alternative chemical source for Advanced Oxidation Processes (AOPs), and was capable of producing hydroxyl and other highly reactive radicals when illuminated with ultraviolet light. These radicals were harnessed to destroy and mineralize small organic molecules and impact the structure of natural organic matter found in surface water. Phase II research will focus on developing a solid understanding of how aqueous chlorine based AOPs can be integrated into overall water treatment processes, compare the efficacies of aqueous chlorine and hydrogen peroxide based AOPs, and demonstrate that solar ultraviolet light can be used to drive this process.

The broader impacts of this research center around the ability to provide a greener, more efficient AOP which can be used to more economically produce high quality water. Phase II research will deliver an increased understanding of chlorine-based AOP technology, enabling the development of products with enhanced capabilities towards the removal of trace organic contaminants from water. Successful completion of this research will positively impact the quality of both drinking water and packaged beverages. In addition, the research could permanently remove contaminants from the environment through mineralization, preventing unintended release from municipal and industrial wastewater plants. Finally, since this process can be driven using solar energy, the resulting technology will be deployable in rural and developing regions of the world at an affordable cost.

NextCAT Inc.

Phase II Award No.: 1127280

Award Amount: $514,830.00

Start Date: August 15, 2011
End Date: July 31, 2014

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Sector: Chemical Technologies

SBIR Phase II: Heterogeneous Catalyst Technology for the Economical Production of Biodiesel from High FFA Feedstocks

This Small Business Innovation Research (SBIR) Phase II project proposes a potentially viable solution for many financially stressed biodiesel producers. Industry estimates that 75% of the installed base of 173 U.S. producers is currently idle. In order become economically viable, they must be able to use less costly, and therefore, less refined agricultural source oils as their feedstock. The R&D presented here builds on a successful NSF Phase I SBIR grant focused on discovering new acidified heterogeneous catalyst formulations capable of refining lower cost feedstocks without adding substantial process costs. Phase II will use these catalysts along with reaction kinetics developed in the subsequent SBIR Phase IB to assemble and demonstrate a pilot-scale biodiesel reactor that will continuously produce FAME from high FFA feedstock (>15% FFA) with a yield greater than 90% for a minimum of six months.

The broader impacts of this research are the ability to simultaneously use low cost feedstock and to greatly simplify the biodiesel production process to achieve total cost saving of ~$1.00/gal. With these savings, retrofitted, currently idled facilities will be able to produce biodiesel fuel that will be cost competitive with petroleum diesel and help meet anticipated global market demand of ~8 billion gallons of biodiesel by 2015. These markets would add employment to economically depressed areas of the United States and bring the nation closer to energy independence.

Northern Technologies International Corporation

Phase II Award No.: 1127552

Award Amount: $500,000.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Sector: Chemical Technologies

STTR Phase II: Advanced Poly(lactide) (PLA) Materials for Extruded and Molding Applications

This Small Business Technology Transfer (STTR) Phase II project proposes to formulate and engineer chemically modified bio-based and biodegradable Poly(Lactide) based compounds, to generate a new class of materials that are, high strength, lightweight, multifunctional, environmentally friendly & cost-effective as an alternative to petroleum based polymers. NTIC has successfully commercialized a portfolio of reactive blended bio-based and/or biodegradable resins for extrusion, molding, and coating applications. However, it faces a major hurdle due to poor mechanical properties, high prices, and higher densities of current PLA materials. NTIC successfully developed novel chemistries of compatibilization to create advanced PLA bio-resins that offer improved toughness in Phase I of this work. The newly synthesized materials were applied in four different processing platforms to provide extruded films, injection molded cutlery, extrusion coated paper, and extrusion blow molded bottles. Phase II funding will allow NTIC to build on the success of the initial trials and build an improved, broader portfolio of high strength and economically viable PLA based products.

The broader impacts of this research are technical, environmental, and economical. This work will (1) widen the window of performance of PLA based applications; (2) further fundamental understanding of PLA and its chemistries (3) greatly increase the use of biobased products in larger industrial and packaging markets implying environmental preservation of fossil fuel resources; and (4) create new jobs for sales, manufacturing, technical support of newly developed Natur-Tec® products.

Novarials Corporation

Phase II Award No.: 1026642

Award Amount: $513,995.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Bendable Ceramic Paper Membranes

This SBIR Phase I project will develop bendable Ceramic Paper Membranes for various applications including oil and gas, automotive, food and beverage, biotech, and pharmaceutical. Bendable ceramic paper membranes possess ultrahigh packing density, excellent chemical and thermal stability, high filtration performance and low manufacture cost. Based on the success of the Phase I program, the Phase II project will fully develop and standardize Bendable Ceramic Membrane Technology and set up a foundation necessary for the large scale commercial manufacture of this innovative technology.

Bendable ceramic paper membrane technology will alter the landscape of membrane manufacturing by improving its economics, product performance, and breadth of applications. This will have a sweeping impact on dozens of industries that either currently rely on membrane technology or represent potential new markets for membranes as a result of this breakthrough. These industries include chemicals, gas and oil, automobiles, food, beverage, biotech, and pharmaceutics, and represent a global membrane separation market of potentially $15.1 billion by 2012. Further, given its potential applications in waste treatment, environmental protection, and green energy conversion and storage, this new membrane technology will have additional far-reaching societal benefits.

Oxazogen, Inc.

Phase II Award No.: 1026556

Award Amount: $472,135.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Oxidation Resistant Carbon Supports For Fuel Cells

This Small Business Innovation Research (SBIR) Phase II project addresses the need in the marketplace for fuel cells with improved durability. Polymer electrolyte membrane (PEM) fuel cells offer a potential environmentally friendly source of power, but performance improvements are required before costs justify more widespread adoption of this technology. Catalyst deactivation limits the lifetime of commercial PEM fuel cells, as the catalyst support is subject to oxidation and the active metal component, typically containing platinum, sinters during use. This Phase II project addresses both of these problems. Through a combination of new technologies from the ceramics, electronics, and catalyst industries, the feasibility of producing new support materials that are much more resistant to degradation has earlier been demonstrated. Accelerated aging studies have shown dramatic increases in catalyst lifetime, as much as tenfold. Building on these successes, the goals of this Phase II project are development of an optimized process for preparation of this new catalyst system and the production of prototype commercial fuel cell power packs with this new catalyst system.These prototype devices will be tested to demonstrate if the improvements shown in accelerated aging studies translate into longer lifetimes in commercial products.

The broader/commercial impact of this project complements the work reported by others in developing fuel cell catalyst systems with higher activity. Fuel cell systems that combine catalysts with high activity and long lifetime lead to the best overall economics. Fuel cell powered systems also have environmental advantages. The use of fuel cells to generate power leads to a significant reduction in greenhouse gas emissions if they replace systems powered by internal combustion engines. Reductions in emissions as high as 25% have been achieved when fuel cell power supplies replace internal combustion powered systems. The technology to be developed can be used in other applications where attack of a carbon substrate under oxidizing conditions leads to degradation which occurs not only in a variety of catalyst applications but also in electrodes for battery applications.

Pearlhill Technologies, LLC

Phase II Award No.: 1127187

Award Amount: $441,549.00

Start Date: August 15, 2011
End Date: July 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: NIFUT Technology for Recycling Fluorides from Uranium Tetrafluoride

This Small Business Innovation Research (SBIR) Phase II project proposes to significantly expand the number of marketable compounds that can be converted from depleted uranium tetrafluoride (DUF4). DUF4 is produced by the reduction of depleted hexafluoride (DUF6), the largest and one of the most toxic waste components of the entire nuclear fuel cycle. Current technology can convert DUF4 into metallic fluorides. Pearlhill Technologies has developed new, environmentally and economically sound processes for the production of nonmetallic inorganic fluorides from uranium tetrafluoride (NIFUT). In Phase I, Pearlhill proved the feasibility of three NIFUT processes to produce commercially viable fluoride products; sulfur tetrafluoride (SF4) gas, sulfur hexafluoride (SF6) gas, and nitrogen trifluoride (NF3) gas. In Phase II, the company will design and develop prototype reactors and conduct field tests for three processes: (1) a scalable batch process to produce SF4; (2) a continuous process to produce SF6 gas by direct fluorination of SF4 in a stationary bed of cobalt trifluoride (CoF3); and (3) a continuous process for the direct fluorination of trimethylsilylamines at a low temperature liquid phase continuous process, in order to produce NF3 gas.

The broader impacts of this research are that, for the first time, a company has created nonmetallic inorganic fluoride products from DUF6. The Department of Energy (DOE) currently has as much as 700,000 tons of DUF6 in its inventory. Meanwhile, four companies are planning to build new uranium enrichment plants. When these facilities are operational, an additional 27,000 tons of DUF6 waste will be added annually to the inventory. DOE's 1999 roadmap for decommissioning DUF6 discussed the need to create new processes for the commercial production of high-value fluorine products from DUF6/DUF4 including a variety of metallic and non-metallic inorganic fluoride compounds, which can be absorbed into current markets. A mix of high-value fluoride products is needed to minimize flooding any single fluoride market. Market research suggests that the market demand for metallic fluoride products can absorb only about ten percent of the potential metallic fluoride gas products that could be created from the annual ongoing enrichment process; hence there is a pressing need to increase the number of markets for fluoride products created from DUF6. The innovative NIFUT process will address this need. The Phase I research has proven that three fluoride products - SF4, SF6, and NF3 - can be produced at a significant cost advantage in the current marketplace.

Phycal LLC

Phase II Award No.: 1152497

Award Amount: $495,763.00

Start Date: April 15, 2012
End Date: March 30, 2014

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Magnetic technologies for improved microalgal biofuels production

This Small Business Innovation Research Phase II project develops novel technologies for separation and concentration of intrinsically magnetically susceptible algae for production of biofuels and biochemicals. Phase II builds on the feasibility demonstrated in Phase I using a model alga. During Phase II, an algal strain used for production of renewable biofuel feedstock will be utilized. Novel transformation vectors and tools developed for a production strain, Auxenochlorella protothecoides, will be used to make the algae magnetically susceptible. These traits provided an advantage vs. wild-type strains in growth in low iron medium for the model alga. Phase II will test modified algal strains at lab- and subpilot-scale to determine their performance in growth, and competition with wild-type and weedy algal strains. Additionally, strains will be tested for their ability to be separated or harvested magnetically. This separation will be modeled to determine cost efficacy for primary or secondary dewatering. The specificity of this separation will also be evaluated in relation to downstream use in a heterotrophic bioreactor. The OSU collaboration allows use of these strains in novel rare earth magnetic separators. The endpoint will be novel technologies to improve the overall cost structure for the production of algae-derived biofuels and biochemicals.

The broader impact/commercial potential of this Phase 2 research project will be to provide improvements in the economics of producing renewable biofuels using algae as the production system. It directly addresses one of the major issues with algal biofuels, cost effective dewatering. It also provides a potential selective advantage of the modified strains by improving its ability to compete for iron in an open environment (such as open raceways or photobioreactors). The nation has a critical need to improve its energy security and reduce its dependence on fossil fuels. This research will help address both of these needs. The overall purpose of this research project is business related and focused on commercialization of this technology through integration in a biofuel production process. This research project focuses on a high cost portion of the production process, dewatering, as well as a critical unit process, the heterotrophic bioreactor. The collaboration with OSU and the Cleveland Clinic will result in training of students in this area. The company plans to publish the results of this project once proper control of the intellectual property generated is accomplished.

PlastiPure, Inc.

Phase II Award No.: 1127553

Award Amount: $488,236.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Flexible Plastic Packaging Without Estrogenic Activity (EA)

This Small Business Innovation Research (SBIR) Phase II project will use resins, additives, and process aids shown by PlastiPure to be free of estrogenic and anti-estrogenic activity (EA**) to create innovative and novel flexible plastic films and products for the preparation and storage of food and beverages that leach no chemicals having EA**. These films and products should remain free of EA** when extracted by common solvents and food simulants, and remain EA**-free after the stresses of manufacturing and exposure to common-use stresses (microwaving, thermal cycling, and UV light). PlastiPure also proposes to produce prototype products which would be specifically targeted for pregnant women, infants, and young children, whom are particularly vulnerable to the potentially adverse health effects of EA**. These highly desirable end products are already being sought by PlastiPure licensees and interested retailers.

The broader impacts of this research are development and commercialization of food and beverage packaging that are significantly safer, especially for pregnant women, infants, and young children. Fetal or juvenile mammals, including humans, are especially sensitive to effects of chemicals having EA** at very low dosages and hence should not indiscriminately ingest such chemicals. EA** has been strongly linked to higher rates of certain cancers, birth and learning disorders, obesity, and reproductive issues. PlastiPure's data show that the vast majority of plastic food packaging leaches chemicals with EA**, including those advertised as BPA-free. This NSF SBIR grant should facilitate a comprehensive reduction of risks to public health and reduced environmental impact from chemicals having EA.

Polnox Corporation

Phase II Award No.: 1138520

Award Amount: $500,000.00

Start Date: Setember 15, 2011
End Date: August 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Novel Antioxidants to Improve Thermo-Oxidative Stability of Biolubricants and Biodiesel

This Small Business Innovation Research (SBIR) Phase II project proposes to develop and commercialize cost-effective high performance macromolecular antioxidants based on Polnox's proprietary "dual type moiety per molecule" (DT-mPM) technology for sustainable-alternate bio-oils. Oxidative stability presents a key issue for industrial bio-oils. These oils, which are derived from bio-resources, have inferior stability compared those derived from fossil fuels. In particular, fuels and lubricants derived from plant-based polyunsaturated fatty acids are especially prone to severe oxidation. It has been demonstrated in Phase I that the DT-mPM antioxidants are significantly more effective in combating degradation of these bio-oils vs. state-of-the-art commercial antioxidants. The current, state-of-the-art, commercial antioxidants do not meet the challenges posed by plant-derived bio-oils. Current antioxidants were developed to protect petroleum lubricants and are simply not capable of meeting the stability issues posed by bio-lubricants. This proposal addresses the key steps involved in the product development of antioxidants for bio-lubricants; namely, (a) molecular design optimization, (b) cost-effective process scale up, (c) preparation of pound scale of lead antioxidants identified in Phase I, and (d) product storage stability.

The broader impact/commercial potential of this project is to play an important role in reducing the nation's dependence on foreign oil and providing a cleaner environment by reducing the pollution of air, soil, water, and the eco-system. Societal benefits from the increased use of bio-lubricants include less potential for environmental pollution (e.g., from loss during use or improper disposal of waste lubricants, accidental oil spillage during industrial use, or off-shore drilling) as well as reduced dependence on imported petroleum as a raw material. However, as oils are developed from renewable alternate energy resources, there are some inherent issues to be addressed: (1) thermo-oxidative stability, and (2) pour-point properties. By addressing the thermo-oxidative stability problem of bio-oils through the development and commercialization of new high performance antioxidants, this will enable the production of higher quality alternate oils that are biodegradable and environmentally safe.

PoroGen LLC

Phase II Award No.: 1048608

Award Amount: $409,578.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Sector: Chemical Technologies

SBIR Phase II: Novel Polymeric Membrane for Hydrocarbon Separation

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a novel membrane for a broad spectrum of hydrocarbon separations. The initial focus of the project is the development of a selective membrane for efficient separation of hydrocarbons from methane in natural gas processing and separation of hydrocarbons from hydrogen in refinery applications. The chemically robust polymeric membrane will be of a composite configuration comprised of a hollow fiber porous support with a superimposed several hundred angstroms thick separation layer. The nano-structured morphology of the separation layer will enable selective fractionation of hydrocarbon molecules.

The broader/commercial impact of this project is the reduction of energy consumption currently used in separation and purification of hydrocarbons found in oil and gas. In addition, if successful, petrochemical industries will reduce emissions of green house gases, including methane and carbon dioxide. The membrane will effect molecular level separation of hydrocarbons and will be capable of operation in harsh environments and at high temperatures. The initial market for this technology is the recovery of natural gas and hydrocarbon liquids from the associated natural gas in remote geographic locations (gas generated during oil production) that is currently flared. Development of the proposed technology will enable recovery of the methane and high value hydrocarbons at the well with extensive economic and environmental benefits. The membrane is expected to find further utility in high value gas and liquid separation applications including hydrogen recovery from refinery fuel gas, olefin/paraffin separation, and generic hydrocarbon fractionation.

Proton Energy Systems, Inc.

Phase II Award No.: 1058328

Award Amount: $559,977.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Prakash Balan

Sector: Chemical Technologies

STTR Phase II: Development of High Temperature Membranes for Increased PEM Electrolysis Efficiency

This Small Business Technology Transfer (STTR) Phase II project aims to develop improved membranes for water electrolysis cells, providing a potentially renewable, cost competitive hydrogen source for fueling and backup power applications. Currently, the membrane contributes substantial efficiency losses, and is also one of the highest cost materials in the cell stack. In Phase 1, feasibility of obtaining increased efficiency using new membrane chemistry was demonstrated. I n Phase 2, Proton Energy will continue research to understand longer term degradation mechanisms and scale up to a relevant level to prove manufacturability. Proton's academic partner, Penn State, will also build on Phase 1 work, using membrane reinforcement strategies to improve robustness. The proposed membranes represent significantly cheaper and more efficient materials for water electrolysis applications, enabling widespread access to hydrogen for a variety of energy uses.

The broader impacts of this research are new market opportunities in electrolysis and fuel cell applications as well as electro-dialysis and other ion exchange technologies. Creating a new class of mechanically robust proton exchange membranes would be a significant advance in the field and would find immediate commercial interest. T h e chemistry proposed has the opportunity to decrease the membrane cost by 75%, as well as increasing the efficiency of the cell stack. These combined effects result in substantial potential increases in Proton's existing markets, which are primarily focused on industrial gas and laboratory applications. This project will also enable new applications markets such as vehicle fueling (including fuel cell fork trucks) and telecom backup power.

Seldon Technologies, Inc.

Phase II Award No.: 1026891

Award Amount: $490,172.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Functionalized multi-walled carbon nanotubes for making highly efficient water separation membranes for ultralow sulfur diesel fuels

This SBIR Phase I project will develop a water separator media to protect heavy duty engines from the water content in modern ultra low sulfur diesel fuels. The ultra low sulfur diesel fuel typically found in the field has very low interfacial tension allowing water to be present in the form of very fine droplets which pass through conventional water separators and end up in the fuel injection system. This project will quantify and develop a functionalized multiwall carbon nanotube-based water separator to be used with all ultra low sulfur diesel fuels on the market with nearly 100% water removal efficiency. The objective is to enhance the separator performance to cost ratio by working to further increase the separation efficiency and lower the media cost through process scaling and materials development.

The broader impact/commercial potential of the project are focused on benefits related to enhanced ultra low sulfur diesel fuel separation, including more consistent fuel delivery to the engine, longer injector/engine life, better combustion of ultra low sulfur diesel fuel, lower maintenance costs, new jobs enabled by the use of high-sulfur fuel reserves, and more efficient combustion of bio-fuels. Reduced water content in the fuel will help to improve performance of the high pressure fuel injection systems, maintain tolerances of the fuel injection system components, and reduce maintenance costs.

Sigma Technologies Int'l Inc.

Phase II Award No.: 1127135

Award Amount: $494,796.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Structural Multifunctional Composites with Energy Storage Properties

This Small Business Innovation Research (SBIR) Phase II project addresses the development of a multifunctional solid-state nanolaminate composite, which may function as a structural material while storing energy in the form of a rechargeable super-capacitor. A unique production process is used, where liquid monomer and aluminum wire are introduced into a process chamber that converts them into a multilayer composite with thousands of polymer and aluminum layers. Applications include storage devices for battery back-up and inverter circuits used in transportation and high energy density capacitors for extreme thermo-mechanical environments, such as aircraft, photovoltaics and aerospace. The Phase I development work demonstrated the production of large area (10sq.ft.) energy storage material. The nanolaminate material has mechanical properties that are close to a hard polymer laminate and energy densities which are an order of magnitude higher than conventional electrostatic capacitors and similar to those of electrochemical super-capacitors, with superior performance at temperatures below -20C and above +65C. The Phase II effort includes development work to optimize certain manufacturing methods, optimization of the polymer dielectric, packaging development, creation of specification sheets based on short and long term life tests and sampling potential customers that represent immediate and long term business opportunities.

The broader impact/commercial potential of this project is in the utilization of a new multifunctional material that can store energy. Such material may be integrated into a structure and save space and weight. It is a green product that requires no water or solvents to produce, it is recyclable and it does not involve the use or disposal of hazardous materials. Nanolaminate energy storage products will be based on mainly two materials, aluminum wire and acrylate monomers, which are commonly used to produce protective coatings for flooring, printing, furniture, window films, etc. Lightweight energy storage nanolaminates can replace double layer electrochemical super-capacitors that have severe temperature limitations and conventional electrostatic capacitors, in applications where volume, weight and thermomechanical constraints such as vibration and operating temperature are limiting factors. Capacitors produced using nanolaminate composites, are solid-state components that can electrically self-heal and have an open-circuit, or fuse-like safe failure mode, which is desirable in applications such as electric vehicles and aircraft, where safety of people in the proximity of a capacitor bank is of paramount importance. Multifunctional materials are expected to play a key role in the future in improving energy efficiencies and reducing dependency on fossil fuels.

Sioux Manufacturing Corporation

Phase II Award No.: 1058155

Award Amount: $425,627.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Prakash Balan

Sector: Chemical Technologies

SBIR Phase II: Innovative Recycled Microballoon Thermoplastic Sandwich Composites

This Small Business Innovation Research (SBIR) Phase II project will develop the next generation of lightweight materials by utilizing recycled thermoplastic composites to achieve energy efficiency and impact protection for transportation and residential and commercial building applications. Previous work showed that combining fiberglass and thermoplastic face sheets and syntactic foam produced composite panels with greater impact resistance than plywood with aluminum facing. This work will expand the materials and processing envelope to produce a series of composite panels fabricated from recycled glass-reinforced/thermoplastic face sheets and a syntactic foam core consisting of glass or ceramic microspheres and regrind or virgin polymer. The use of hollow microspheres allows the achievement of both low weight and high impact strength while using low-cost extrusion-compression processing techniques. This configuration can be readily tailored to produce panel applications as varied as truck trailer bodies or for protection against flying debris caused by hurricane-force winds.

The broader impacts of this research are the increased use of recycled materials to decrease the weight of commercial transport vehicles, resulting in increased fuel economy and decreased degradation of roadways and bridges. Also, improved systems for impact protection during hurricanes will result in less damage to commercial and residential structures and the loss of fewer lives. The technology of combining hollow ceramic microspheres from the ash of power plants with re-ground polymer waste will produce a material with unique properties that can be applied to a variety of commercial applications.

zuChem, Inc.

Phase II Award No.: 1026787

Award Amount: $515,996.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Chemical Technologies

SBIR Phase II: Conversion of Biodiesel Glycerol to Xylitol Co-Product

This SBIR Phase II project will develop a method to convert the byproduct glycerol to a value-added co-product, xylitol, thereby helping to reduce the costs associated with biodiesel production. The anticipated result is a scalable process capable of converting crude glycerol to xylitol in a single step bioreactor process and a demonstrated method for recovery of the value-added product.

The broader impact/commercial potential of the project will be to further biodiesel as a replacement for petrochemical diesel. Converting the main by-product of biodiesel production, glycerol, to a value-added product would improve the economics of biodiesel, while removing a waste stream and providing a reduction in price of the co-product. Xylitol itself also has beneficial societal impacts including anti-carcinogenic effects as a safe sweetener for diabetics, and it does not promote new cases of diabetes as some sweeteners are suspected of doing.

CellTech Power LLC

Phase II Award No.: 1127175

Award Amount: $499,993.00

Start Date: October 15, 2011
End Date: September 30, 2013

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Sector: Environmental Technologies

SBIR Phase II: High Efficiency BioMass Power Generation Using Liquid Tin Anode Fuel Cell

This Small Business Innovation Research Phase II project will continue the commercial development of the Liquid Tin Anode Solid Oxide Fuel Cell (LTA-SOFC) for direct conversion of biomass to electrical power. The LTA-SOFC is a transformational energy technology that dramatically increases the efficiency and simplicity of power generation from conventional fuels. In biopower, the LTA-SOFC provides a pathway to improve efficiency and capital cost and also enables smaller scale applications. Phase I successfully demonstrated the feasibility of direct biomass conversion to power, using biomass feed stocks which can have significant societal, environmental and economic impacts. Specifically in Phase I several different types of biomass including poplar and switchgrass were used to generate power in an actual LTA-SOFC cell. Post-test analysis indicated no ash fusion and near 100% fuel utilization (little residual carbon left). The Phase II effort will continue development of biopower applications for LTA-SOFC by demonstrating biomass fuel efficiency in a small stack assembly with continuous feeding. Also, evaluation of the fate of biomass-specific volatile components such as potassium will contribute to the understanding of LTA-SOFC longevity. Phase II will demonstrate additional LTA-SOFC biopower technical performance to reduce risk and increase the potential for commercialization of LTA-SOFC biopower.

The broader impact/commercial potential of this project will be increased use of renewable power. Currently biomass contributes only 1% of U.S. electric power despite available resources to provide over 20%. Increased use of biomass for electric power will reduce carbon emissions, increase energy security and create domestic jobs. Efficiencies lower than 20% and high capital cost of today's technology make conventional biomass power about twice as expensive as coal limiting market penetration to about 1%. LTA-SOFC Direct Biomass generators will reduce the cost of power and lower capital cost while reducing emissions and feedstock consumption by 2-3 times. The EIA predicts that by 2030, biomass will generate 4.5% of U.S electricity, representing an available market for LTA-SOFC of about $30 billion. The LTA-SOFC commercialization strategy starts with small devices. Growth into commercial markets will provide the maturity required for more demanding biomass power markets. In the biopower area military users have powerful adoption incentive that will encourage them to become early adopters. The US defense establishment has a goal to use renewable energy for 25% of the facility electrical consumption by 2025. This SBIR will reduce technical risk, providing confidence for integrator partners to co-invest in commercialization of LTA-SOFC biomass generators.

Cool Energy, Inc.

Phase II Award No.: 0848689

Award Amount: $1,115,775.00

Start Date: January 15, 2009
End Date: June 30, 2013

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: Solar Thermal Stirling Engine Combined Heat and Power System

This Small Business Innovation Research Phase II project advances the development of an integrated solar energy system which delivers heat and electrical energy to a building's occupants. At Cool Energy, development continues on the SolarFlowTM System, a solar thermal system for combined heating and electrical power generation from medium-temperature heat energy (100-300°C) captured with evacuated-tube solar thermal collectors. The innovative system design integrates high-performance solar collectors with a novel advanced-materials Stirling engine and controller to use a single solar system to produce electricity and thermal energy for space and water heating. Economic value to the customer is maximized using an optimizing predictive control system to regulate the delivery of heat and electricity. Building on the successful Phase I program for selection of advanced engine components and the demonstration of significant electricity production from the engine prototype, the Phase II demonstration program encompasses system integration of the next-generation Stirling engine prototype with the system controller and solar collectors. The core intellectual merits are the advances in the Stirling engine design (with broader applications than solar power), the implementation of the predictive control system, the integration with the solar collectors for field testing, and the advanced engine and system design tools.

This project supports a technology demonstration that has enormous potential for helping to replace the world's depleting supply of highly polluting fossil fuels with cleaner, sustainable sources of energy. The costs of traditional energy are rising rapidly, causing significant hardship to much of the world's population, including in the US. Disproportionate effects are visited on the poor as the costs of heating fuels and electricity escalate. Rising carbon emissions threaten ecosystems and human populations worldwide over the coming centuries. Cost reduction of renewable energy technology is a main driver of this Phase II demonstration project, as only through lowered costs of clean energy will the US and the world be able to attain domestic energy security, economic stability, and environmental responsibility. Concentrating on market success to enable widespread adoption, Cool Energy has expended a great deal of effort on modeling the economics of the SolarFlow System in various regions of the US. Further, partnerships have been cultivated with potential customers, distribution partners, manufacturing partners, and investors to build a strong business foundation to foster rapid penetration of this technology into commercial channels upon its successful demonstration.

EcoHarvester, Inc

Phase II Award No.: 1127526

Award Amount: $499,734.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: Low-Profile, Multi-Polar Energy Generator (MEG) for Small Scale Power Applications

This Small Business Innovation Research (SBIR) Phase II project proposes to create high performance energy harvesting products using EcoHarvester's Multi-Pole Energy Generator (MEG) technology. The novel platform technology will answer the need for power in the mili-watt to several watt ranges and will be possible to serve multiple markets. Phase II will focus on miniaturization of the MEG technology, system level integration of wireless light switches, and modification of the MEG technology for application to a user-actuated portable electronic device charger. The self-generated light switches will eliminated the cost and time spent on wiring or changing batteries. The user-actuated chargers will eliminate the need to buy disposable batteries for smart phone power back-up.

The broader impacts of this research are further investment in energy harvesting and accelerate the adoption of energy harvesting technologies to replace/supplement batteries. In addition to the great economic and performance advantages of our technology for end users, there are compelling motivations to promote this technology for reasons of sustainability and waste reduction. Locally generated power is highly desirable due to the inherent inefficiencies of transmission and storage. As our world becomes increasingly wired, the demand for environmentally burdensome batteries and copper wires has skyrocketed, creating problems related to material extraction, processing, and disposal. The limitations of batteries also constrict the useful life of many devices and limit some applications due to the need to be able to service and replace components.

Energetiq Technology, Inc.

Phase II Award No.: 1127205

Award Amount: $487,023.00

Start Date: October 15, 2011
End Date: September 30, 2013

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Sector: Environmental Technologies

SBIR Phase II: An Improved Open-Path FTIR Spectrometer for Remote Monitoring of Atmospheric Gases

This Small Business Innovation Research (SBIR) Phase II project will enable Energetiq Technology, Inc. to develop and commercialize an advanced Open-Path FTIR Spectrometer (OPFTIR) instrument for monitoring of atmospheric gases over extended distances. The Phase II technical goals will be the optimization of a high-brightness infrared source and optical subsystem that will enable long path instrument capabilities. For current FTIR instruments the infrared light source is a thermal blackbody, limited to operating temperatures of approximately 1000 C.For OP-FTIR instruments the consequences of relying on such low-brightness light sources are (a) bulky and expensive IR optics; (b) expensive IR detectors; and (c) limited monitoring range - typically less than a few hundred meters. The laser heated IR light source developed in Phase I has demonstrated greater than 2000C operation. Direct comparison with a standard Globar™ source shows an improvement in signal amplitude of between 2 and 10 (depending on wavelength) and signal to noise measurements imply an improvement in detectability of from 1.5 to about 6.

The broader impacts of this research are in the area of environmental monitoring and potentially in Homeland Security applications. The cost and size of OP-FTIR instruments will be reduced and the range and sensitivity increased. With increased emphasis on monitoring total fluxes of atmospheric pollutants, including global warming gases such as CO2, OP-FTIR instruments will be even more widely used in the future.

EnSolve Biosystems, Inc.

Phase II Award No.: 1152257

Award Amount: $445,278.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Ruth M. Shuman

Sector: Environmental Technologies

SBIR Phase II: Biological Treatment of Hydrocarbons in Shipboard Exhaust Gas Cleaning Systems

This Small Business Innovation Research (SBIR) Phase II project will address new regulations being enacted in the shipping industry requiring Sulfur Oxides (SOx) reduction from engine emissions. Many commercial scrubber systems effectively remove SOx from engine emissions, yet none are designed to remove polycyclic aromatic hydrocarbons (PAHs). EnSolve's approach is to develop a combined biological and mechanical system that can remove PAHs from the scrubber system waste water. The results of the Phase I study confirmed the biomechanical approach was effective in reducing PAHs at rates exceeding 99%.

The broader impacts of this research will be to provide the maritime industry with a cost effective, reliable, and environmentally conscious treatment system for removing toxic substances from the world's oceans. Ships will be required to either install scrubbing equipment or they will need to switch to more costly low sulfur fuels. A switch to low sulfur fuel would increase current fuel costs by over 88%. A commercial ship owner could realize annual savings of $2 million per vessel in fuel costs using a scrubber system compared with purchasing low sulfur fuel. An estimated 35,000 ships will be impacted by these regulations, yielding a market opportunity for the proposed scrubber water treatment system exceeding $5 billion. Other technologies under development utilize pure physical separation methods that transfer the contaminants from the scrubber water to another medium (i.e., filters) for disposal. Conversely, the proposed biological approach is a regenerative process that would significantly reduce landfill disposal, consumable, labor, and liability costs.

Green Revolution Cooling, Inc

Phase II Award No.: 1127222

Award Amount: $452,695.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Sector: Environmental Technologies

SBIR Phase II: Fluid Submersion Cooling for Energy and Cost Efficient Data Centers

This Small Business Innovation Research Phase II project proposes to commercialize liquid submersion cooling for computer servers. Liquid submersion cooling involves submersion of heat-generating components in a non-electrically-conductive liquid, replacing air as the heat transfer medium. Liquid is significantly better than air to transfer heat, but historically has required cost-prohibitive capital expenditures due to the added complexity of previous liquid cooling architectures. The research objectives are to produce a system capable of being mass produced at low cost, and with compelling system features that drive customer demand.

The broader impact/commercial potential of this project includes lowering of one of the largest marginal contributors to US electricity use. The EPA estimates that data centers now use nearly 3% of US electricity, up from nearly 1% in 2000, with nearly half of power being driven by using air as the primary heat transfer medium. This high-efficiency system offers the potential to cut total energy use by nearly 50% by nearly eliminating energy for cooling and reducing server power through internal fan removal, while offering higher cooling performance and lower costs. Also, this new heat-recapture system offers the potential to eliminate nearly all server energy in many locales. Alternate cooling solutions that are cost effective only offer marginal improvements, and as computing becomes a larger part of the economy, the search for more energy and cost efficient technologies will become more critical.

GRT, Inc.

Phase II Award No.: 1152638

Award Amount: $500,000.00

Start Date: April 15, 2012
End Date: March 31, 2014

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Sector: Environmental Technologies

SBIR Phase II: Enhanced materials for renewable fuel production and efficient emission reduction

This Small Business Innovation Research Phase II project will expand on the successful work from Phase I project on synthesis and characterization of metal oxide nanocomposite materials that can capture HBr and be regenerated to produce bromine. The capture and regeneration capabilities of these materials are integral to the economic viability of the GRT Gas-to-Fuels/Chemicals rocess and the GRT Propane-to-Propylene Process. In the GRT Processes, natural gas alkanes are (1) reacted with bromine to form reactive lkyl bromides that are (2) reacted over catalysts to produce alkanes, aromatic compounds and olefins. The metal oxide nanocomposite was ound very efficient at sequestering HBr produced in the process as a metal bromide. The use of metal oxides allows for a very inexpensive eparation of HBr from the hydrocarbon products. Subsequent oxidation of the metal bromide produces bromine. Thus the bromine needed in 1) is generated in situ as necessary and is fully contained within the process. During Phase I, we identified metal oxide nanocomposite materials with favorable capacity and capture-regeneration cycle stability that makes industrial use economic. The proposed work is targeted at conducting further testing of these composite nanomaterials on a larger scale and in combination with other Process steps.

The broader impact/commercial potential of this project is that it can contribute to the urgent need for methods to economically produce renewable hydrocarbon fuels and high value chemicals that are more efficient than existing technologies. GRT is developing novel processes for the conversion of methane, ethane and propane into higher value hydrocarbons suitable for gasoline and jet fuel blend stocks, aromatic compounds or high value chemicals which can cost-effectively utilize stranded and/or small reserves of natural gas and shale gas. This upgrade of inexpensive natural gas to high value transportation fuels and chemicals at the source is very valuable because it eliminates the need for gas processing and pipeline transportation. The commercial viability of these technologies depends on energy efficiency and the capital cost of plant equipment. Improvement in the performance and stability of solid reactant/metal oxide nanocomposite materials will make substantial improvements in both of these metrics and hence in the commercial viability of the GRT Processes.

Innovative Energy Solution

Phase II Award No.: 1127521

Award Amount: $448,771.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Sector: Environmental Technologies

SBIR Phase II: Clean, Inexpensive, and Carbon-free Energy from a Toxic Waste

This Small Business Innovation Research (SBIR) Phase II project proposes to commercialize a new process to recycle petroleum toxic wastes to clean and inexpensive energy. This Phase II project will scale the improved process by modifying the company's pilot unit to incorporate the enhancements realized with the bench scale unit in Phase I. The basic SuperATR is a non-catalytic process that employs a cyclic flow reactor filled with an inert packed bed. In the cyclic flow reactor, the direction of oxidizer/fuel mixture is periodically reversed producing a high temperature volume. The modifications in the Phase I project effectively raised the temperature even higher to make the reactor even more efficient.

The broader impacts of this research are that deteriorating qualities of oils and gases is forcing the petroleum sector to incur very high cost for energy and waste disposal. For example, the benign disposal of hydrogen sulfide costs oil refineries and natural gas processing plants $5 billion a year. Present technologies only permit extracting the sulfur content while wasting the much more valuable hydrogen portion. In commercializing this technology, the value propositions are but not limited to: Obtain 9 billion kilowatt hours of carbon; free electricity and steam inexpensively; lowering gasoline and diesel prices, even by 1 cent per gallon, would leave $2 billion in the hands of Americans; eliminate 5 million tons of greenhouse gas along with 1.5 million tons of acid rain pollutants by helping refineries and natural gas plants exceed environmental standards.

Inscent, Inc

Phase II Award No.: 1058580

Award Amount: $534,234.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Environmental Technologies

SBIR Phase II: Rapid Detection of Fecal Contamination in Drinking Water

This Small Business Innovation Research (SBIR) Phase II project concerns a novel, rapid and cost effective detection system for fecal contamination in water supplies. Although existing methods can detect fecal contamination in water samples, improvements are needed in sensitivity, accuracy, and speed. This proposal describes the refinement of a novel sensor utilizing an insect chemosensory protein as the recognition element in a product that detects indole, a characteristic metabolite of coliform bacteria. The biosensor acts with high specificity and sensitivity, allowing the rapid detection of low level E. coli or fecal contamination in water supplies, and encompasses a novel implementation of lateral flow technology that can be used at home or in industry.

The broader impacts of this research are that insect CSP-based biosensors as described constitute a platform technology with direct applications in the detection of environmental, chemical, or biological compounds or contaminants, including the detection of harmful volatile organic compounds (VOCs), quality control of foods and pharmaceuticals, the detection of toxins or stereoisomers generated during chemical or pharmaceutical synthesis, and the detection of volatile compounds present in weapons or explosives. These biosensors can also be used in medical diagnostics as well as numerous other applications where high speed, sensitivity and analyte selectivity are required. The platform technology has immediate application to a variety of important sensor and detector implementations that affect numerous industries, public safety, and public health. The water safety monitor described herein is only one example of the applications possible.

LaunchPoint Technologies, LLC

Phase II Award No.: 1058556

Award Amount: $499,800.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Environmental Technologies

SBIR Phase II: Magnetically Actuated Valve System

This Small Business Innovation Research (SBIR) Phase II project is dedicated to development and testing of Magnetic Valve System (MVS) enabling implementation of electronically controlled variable timing on camless internal combustion engines. MVS is an advanced actuator for intake and exhaust poppet valves utilized in internal combustion engines for control of flows of fresh charge and exhaust gases. LaunchPoint Technologies, Inc. will design and build the MVS actuator and demonstrate its operation on an experimental internal combustion engine. The advantages of MVS technology originate from the nature of the magnetic spring actuator that provides efficient control of the valve position and speed during valve opening and closing events. LaunchPoint's cost-effective and robust technology will enable implementation of highly anticipated electronically controlled variable valve timing on a mass production engine.

The broader impacts of this research are a combination of significant improvements in fuel efficiency, reduction of emissions, and improved power characteristics of conventional spark ignition and compression ignition engines. When a reliable, electronically controlled system is delivered, the economic and social impact of this technology will be broad. The MVS actuator can potentially be used in millions of internal combustion engines employed in automobiles, trucks, bulldozers, and stationary generators. It will enable implementation of emerging advanced combustion technologies such as Homogeneous Charge Compression Ignition and Compressed Air Hybrid. Widespread adoption of MVS actuators would result in substantial decrease of petroleum usage, adverse effects on the environment such as air pollution and greenhouse gas production, and improve energy independence.

MetaMateria Technologies LLC

Phase II Award No.: 1152676

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Environmental Technologies

SBIR Phase II: Waste Water Phosphorus Removal Using Nano Enhanced Reactive Iron Media

This Small Business Innovation Research (SBIR) Phase II project will continue development and commercialization of a nano-engineered high capacity sorption media for removal and recovery of phosphorous from water. This media addresses issues caused by nutrient-related pollution, which significantly affects drinking water supplies, aquatic life and recreational water quality. Phosphorus comes primarily from agriculture and waste treatment sources, including on-site generated wastewater and is the limiting nutrient that usually controls eutrophication in temperate climates. Better, low maintenance/ lower cost approaches are needed to reduce discharge levels. In Phase I, the feasibility of a high performance phosphorous removal media was demonstrated, showing a sorption capacity that is significantly greater than other media reported in the literature. The feasibility of phosphorous recovery and media regeneration was also shown. In Phase II, the sorption of the media will be improved further and will be tested in both the laboratory and as add-on tertiary systems that will be designed, fabricated and operated in the field with the help of commercialization partners. Scale up of manufacturing and regeneration processes will be examined. Successful completion will lead to a superior phosphorous removal media and data required for commercial introduction of products that are needed for wide scale commercialization into the market.

The broader impacts of this research are that phosphorus originating from smaller on-site wastewater systems and water runoff from agricultural and other locations is becoming recognized as a major cause of impairment to streams and lakes and degradation of the water bodies like the Florida everglades. Efficient, low maintenance technologies are needed to reduce discharge levels and a lack of effective solutions exists today. Removing phosphorus is common at municipal wastewater treatment plants where chemical flocculation is available, but such approaches are impractical for dispersed sources of generated wastewater. Lower cost approaches are also desirable for these municipal treatment plants. This new media will have a much higher capacity and longer life. This will provide an economic alternative to mitigate the negative effects that phosphorous has on the environment and will offer ways for recovering the economic value of the phosphorous, a non-renewable resource that is necessary for food production and which is becoming limited in supply. Further development and optimization is warranted to move toward verification in field trials that will accelerate the commercial use of this new phosphorous removal technology.

Microbial Insights Inc.

Phase II Award No.: 1056963

Award Amount: $499,999.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Environmental Technologies

SBIR Phase II: Microbial Source Tracking Using Mitochondrial DNA for Identification of Contaminant Sources

This Small Business Innovation Research (SBIR) Phase II project will result in field validated microbial source tracking (MST) assays that provide cost-effective identification of sources of fecal pollution. Despite efforts mandated under the BEACH and Clean Water Acts, beach closures have exceeded 20,000 days in each of the last four years primarily due to fecal pollution. The problem continues because traditional methods cannot identify the sources of fecal contamination (sewage, livestock, domestic animals, wildlife). MST assays employing quantitative polymerase chain reaction (qPCR) were developed to quantify source-specific genetic markers encoded on the mitochondrial DNA (mtDNA) of the source animal (human, cattle, dog, etc.). The Phase I results demonstrated that mtDNA-based assays combined with bacterial source tracking methods will provide conclusive identification of fecal contamination sources allowing implementation of corrective measures to improve water quality and protect human health. Phase II studies will include a modification of the DNA extraction procedure to permit quantification of live fecal bacteria to aid in risk assessment and extended field validation studies at two beaches and two coastal watersheds impaired by unknown sources of fecal pollution.

The broader impacts of this research are that the MST assays developed and validated during the Phase II project will empower stakeholders with the type of actionable data required to identify fecal contamination sources, implement appropriate corrective actions, and safeguard the nation's waters. Fecal contamination of water resources currently exacts a severe toll in terms of increased risks to human health and impacts on coastal economies.

NanoVoltaix, Inc.

Phase II Award No.: 1152665

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Environmental Technologies

SBIR Phase II: Development of Nanoporous Geopolymer Composites as Adsorbent for Arsenic Removal

This Small Business Innovation Research (SBIR) Phase II project focuses on the development of a novel, environment-friendly adsorbent material with low life-cycle cost for the removal of Arsenic from the water stream. The proposed material solution is based on a novel nanoporous geopolymer composite designed specifically for this application and manufactured via a patented, sustainable, and energy- and materials-efficient production process. During Phase II, the superior performance of the new media demonstrated at lab scale in Phase I will be further validated at the pilot scale. The anticipated results include 1) successful pilot production of the novel adsorbent to validate the cost advantages of materials; 2) successful validation of superior performance of the nanoporous composite at a pilot testing scale; and 3) further improvement of the product cost by using lower cost precursors.

The broader impacts of this research are (1) providing to the environmental remediation industry a new class of materials and novel platform technology that may be expanded to removing other water contaminants. The novel material will be offered to replace the existing sorbent media and will provide performance/cost benefits for residential and commercial systems with additional environmental advantages; (2) enabling the development of new fresh water sources currently unusable due to high Arsenic content in the US and developing countries; and (3) transforming the nanoporous materials production technology with a broad spectrum of critical clean tech applications, including energy efficiency (insulation and catalyst), energy generation, and energy storage.

Omega Optics, Inc.

Phase II Award No.: 1127251

Award Amount: $500,000.00

Start Date: October 15, 2011
End Date: September 30, 2013

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: Low Cost On-Chip Photonic Crystal Slot Waveguide Absorption Spectrometer for Highly Sensitive, Continuous,In-Situ,Remote Specific Detection of Multiple VOC in Water

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a low cost packaged near-infrared on-chip silicon absorption spectrometer for simultaneous and specific detection of multiple volatile organic compounds in water (ground water, waste water and drinking water). In phase I, the volatile organic compound xylene was successfully detected in water at 100 parts per billion through near-infrared absorption signatures, on chip with 300 micron long photonic crystal slot waveguides which represents the best results in device sensitivity and in miniaturization. The device combines slow light effect in photonic crystal waveguides with highly concentrated optical field intensity in a low index slot at the center of the photonic crystal waveguide. The photonic crystal slot waveguide proposed herein provides a factor of 1000 reduction in interaction length compared to conventional waveguides leading to enhanced optical absorption by analytes in the optical path. Transmission is measured from multiple waveguides covering the entire near-infrared wavelength range, and absorbance determined by measuring transmission differences in the presence and the absence of any volatile organic compound analytes of interest. The miniature spectrometer will enable massively parallel identification and high throughput analysis.

The broader impacts of this research are the enabling of continuous, remote, in-situ monitoring and unique identification of multiple volatile organic compounds (VOCs) in groundwater, drinking water, and waste water, with high sensitivity and specificity, a facility that is not available commercially at present. The integrated silicon platform ensures low cost production in high volume. From commercial standpoint, the United Nations Environment Program estimates the global water market to expand to $660 billion from the current $250 billion by 2020. The proposed photonic crystal slot waveguide device can be expected to occupy a significant position in this market. The generalized design of the proposed versatile technology implies possible implementation in multiple areas of in-situ analyte sensing, detection, and spectroscopy such as control of food, air, and water quality and health, in a lab-on-chip platform with low cost of ownership. Through continuous, in-situ and remote monitoring, the prototype developed from this research will eliminate the lag time that currently exists in industrial water monitoring, sometimes extending to few months as in VOC monitoring of rivers and lakes, thereby enabling early warning of spurious leaks and spills instead of after-the-fact damage control and mediation and thus enhance environmental and national security.

OndaVia, Inc.

Phase II Award No.: 1058590

Award Amount: $461,020.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: Hand-Held Device for PPB-level Water Analysis

This Small Business Innovation Research (SBIR) Phase II project will move OndaVia's water contaminant detection technology from proof-of-concept to commercial prototype. As experts in microfluidic design, OndaVia uses its innovations to manufacture devices that provide near real-time, precise water analysis in the field. Our Phase I SBIR project goal was to prove the feasibility of detecting 100 part-per-billion-level water contamination using an embedded surface-enhanced Raman spectroscopy (SERS) region within a microfluidic channel'a goal achieved with excellent results. The objective of this Phase II effort is to build a prototype water analysis system, the anticipated results of which will set the stage for rapid incorporation of this proprietary detection technology into OndaVia's line of analytical instruments.

The broader impacts of this research are emphasized by the belief that the world is running out of 'quality' water. Reservoirs are depleting, ground water is frequently contaminated through petroleum extraction, and new industrial contaminants are found in lakes and rivers every day. Typical analysis requires collecting a sample in the field and shipping the sample to a test laboratory; water monitoring agencies depend upon these outsourced laboratories where transport and processing time can take days to produce results, wasting precious time when the health of a community is at stake. Field-ready, real-time measurement tools that detect a wide array of compounds at a parts-per-billion or better level would be a powerful, valuable, and necessary addition to the water testing toolbox.

OnTo Technologies

Phase II Award No.: 0750552

Award Amount: $1,042,000

Start Date: January 1, 2008
End Date: June 30, 2012

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: Recycling Advanced Batteries

This Small Business Innovation Research (SBIR) Phase II project will develop process conditions, recycled materials, and recycling of new battery technologies. Phase I demonstrated that the innovative recycling process can produce materials for new batteries from spent batteries. The Phase II recycling research objectives will (1) Survey advanced battery technologies (2) Improve process efficiency and (3) Recondition used materials. Starting with spent batteries, the project recovers materials, examines utility, and develops methods for recondition based upon physical or chemical limiting issues. The anticipated result of this development is establishment of the most efficient process to recycle high performance battery materials.

The proposed project establishes the most environmentally friendly advanced battery recycling technology as the solution to the next generation's significant environmental challenge. Today's battery recycling options inefficiently bury, burn, or melt spent batteries. This project addresses needs from battery-reliant industries for low-cost recycling with minimal environmental impact; the developed recycling process is the basis for jobs fundamental to the future portable electronics and electrified vehicle markets. The innovation is based upon knowledge from battery life-limiting mechanisms coupled with green-chemical processing techniques. The research actively involves undergraduate researchers at Willamette University in the development and commercialization of energy efficient technologies.

Pearlhill Technologies, LLC

Phase II Award No.: 1151935

Award Amount: $475,946.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Ruth M. Shuman

Sector: Environmental Technologies

SBIR Phase II: Photochemical Reactor for CO2 Separation in Carbon Capture Process

This Small Business Innovation Research (SBIR) Phase II project will stimulate the acceptance of carbon capture by companies that own and operate coal-fired plants. The Department of Energy considers the amine absorption of carbon dioxide (CO2) from flue gas of coal-fired power plants as the most advanced, most well understood, and most successful method for carbon capture. In this process, monoethanolamine (MEA) solvent is used in a thermal process for desorption and carbon capture. Unfortunately, the thermal process is very inefficient, requiring a 30% increase in coal usage for to capture the CO2. The Phase I research proved the feasibility of replacing the inefficient thermal process with a new, innovative photolytic process that has the potential to dramatically cut the 30% increase in coal usage by more than half. The first part of the Phase II project will focus on developing an efficient photolytic prototype reactor that will dramatically reduce the costs of capturing CO2 as preparation for field tested at a power plant. The Phase II objectives will focus first on optimizing the reactor processes that affect desorption and capture. Then, using the resulting data, the team will design and build the prototype reactor.

The broader impacts of this research are that it has the potential to make carbon capture at coal fired power plants significantly more cost effective for the power producer. For example, by retrofitting the photolytic technology, a 100-500 MWe power plant could save as much as $17 MM annually. With this type of saving, an investment by a power plant in the photolytic technology is likely to produce a very high rate of return, whereby the cost of adding the photolytic reactor process could be recouped in approximately three years. The World Coal Institute reports that coal's share of global electricity generation is set to increase from 41% to 44% by 2030. In the United States, electricity generation accounts for approximately 40% of total CO2 emissions and more than 80% of these emissions come from coal fired power plants. Near-term CO2 capture technologies raise the cost of electricity (COE) produced at these plants by 60-90%, and impose a 25-35% parasitic coal-burning load. As the U.S. searches for ways to reduce CO2 emissions, maintaining coal as a viable source of low-cost electric power critically depends on finding more cost effective ways to capture the CO2 produced. The energy efficient photolytic process developed in this project has the potential of reducing the increase in the COE for carbon capture from the current 60-90% for the thermal process to less than 35%.

QM Power, Inc

Phase II Award No.: 1152391

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Ruth M. Shuman

Sector: Environmental Technologies

SBIR Phase II: Advanced Portable Power Generators

This Small Business Innovation Research (SBIR) Phase II project evaluates a low cost, high efficiency portable power system called the QM Power "PoD" (Power on Demand). The PoD will power handheld consumer electronic devices (cell phones, tablets, laptops etc) utilizing a rechargeable battery and an advanced, mechanical energy generator system. QM Power, in conjunction with development partner Dell Engineering Services, will complete the design, analysis, prototyping and system integration of its generator technology into the PoD and will evaluate various accessories which allow the user to input mechanical energy via a crank, gravity assist mechanism or other methods. Research results from the Phase I effort indicate that utilizing QM Power generator technology in an auxiliary power/recharging system has the potential to reduce human input requirements by over 30% compared to state-of-the-art product offering now available.

The broader impacts of this research are that the PoD will enable users to obtain critical power on demand and provide substantial environmental and public benefits (reducing grid dependence, disposable battery issues and providing power to emerging markets that lack access). Mobile devices have become increasingly power hungry while advances in battery energy density have not kept pace. As a result, the length of use, mobility, and ease use of these devices have been hampered. The QM Power PoD is designed as a hybrid, auxiliary power pack solution that combines a longer life rechargeable battery solution with a supplementary source of renewable, on-demand power that does not require access to the grid.

Rheonix, Inc

Phase II Award No.: 1057685

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: A Fully Integrated Molecular Biosensor for Rapid Monitoring of Recreational Water

This Small Business Innovative Research (SBIR) Phase II project will complete the development of a rapid biosensor for the detection of fecal contamination in recreational water (both fresh and marine). Under current EPA guidelines, marine water should be tested for the presence of enterococci while fresh water can be tested for either enterococci or E. coli, but all testing is hampered by a 1-2 day delay before results are available. The current project will permit this testing to be completed in approximately 3 hours, thereby dramatically improving the safety of U.S. recreational waters. It will also provide the US EPA with a means to satisfy a court-ordered requirement to reduce the time of current recreational water testing to 'same day' results.

The broader impacts of this research are that the CARD™ technology can also be used to test water parks and swimming pools for other pathogenic microorganisms. Moreover, the CARD ™ technology can be used in other markets such as drinking water safety, food/beverage testing, therapeutics manufacturing, personal care product testing, and human/veterinary diagnostics. In addition, since the fully automated, portable system does not require operator input, individuals of varying skill levels will be able to easily perform sophisticated molecular assays that would otherwise have required extensive training and equipment. Therefore, in applications that require rapid turnaround of results, such as production floor analysis of in-process or finished products requiring bio-burden analysis, the CARD ™ technology will provide an economical and easy solution to improving manufacturing efficiencies.

Sensor Electronic Technology, Inc.

Phase II Award No.: 1026217

Award Amount: $475,227.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Environmental Technologies

SBIR Phase II: UV LED Lamp Based Water Disinfection for POU Compact Purification Systems

This SBIR Phase I project will establish a commercial water disinfection system based on the use of light emitting diodes that would be appropriate for use in residential settings. The Phase II effort will redesign the system so that the removal efficiency may be enhanced and the packaging of the system will be more versatile. An enhancement of the efficiency would be accomplished by minimizing the optical loss. The repackaging would be accomplished by changing the external casing for the device from stainless steel to plastic material and also encapsulating the light emitting diodes.

The broader impact/commercial potential of the project is the development of commercially viable and environmentally safe technology for UV water disinfection. The primary market segment addressed through the work that will be performed under this Phase II effort is the microbial disinfection of water for point-of-use and point-of-entry applications in household systems, appliances, and remote and rural areas. Incorporation of innovative UV light emitting diode (LED) lamps in water purification modules will enable cost effective and environmentally friendly technology for water purification designed for a variety of water supplies including residential, remote, and emergency relief.

Structured Materials Industries, Inc.

Phase II Award No.: 1058439

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Environmental Technologies

STTR Phase II: Graphene Based NOx Detector

This Small Business Technology Transfer (STTR) Phase II project will develop a low-cost, high sensitivity detector for nitrogen oxides (NOx). The detector will be based on the recently discovered material - graphene. In its most elemental form, graphene consists of a single layer of carbon atoms arranged in a hexagonal array. Since first isolated in 2004, scientists have been rapidly documenting the unusual physical and electrical properties of graphene, and the many potential commercial applications of this unique and multifunctional material. Gas detectors, such as the presently proposed NOx sensor, will be the first commercial application for graphene based devices. Graphene films can potentially detect down to a single molecule of an adsorbed gas.

The broader impacts of this research are that the availability of an effective, inexpensive NOx sensor will enable closed-loop control of engine conditions in auto and truck applications, allowing manufacturers to simultaneously optimize vehicle performance and fuel economy, while maintaining NOx emissions within standards. A portable version of the inexpensive NOx sensor will also enable emissions monitoring for a wide range of other industrial and regulatory applications. In addition, the technology developed will extend the knowledge base for graphene material processing and device applications. Many more applications for graphene are possible, ranging from high speed transistors to spintronic devices to radiation detectors (THz through infrared to optical) to NEMS devices. Graphene also offers the potential to combine these functions into a single device.

United Environment & Energy, LLC

Phase II Award No.: 1127426

Award Amount: $447,667.00

Start Date: December 1, 2011
End Date: November 30, 2013

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Sector: Environmental Technologies

STTR Phase II: Waste Cooking Oil and Fly Ash Based Bioasphalt

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a high performance, environmentally benign, and low cost renewable bioasphalt from recycled agricultural byproduct. The availability issue of petroleum based asphalt, along with the high cost of petroleum and the fuel price to transport the asphalt from a centralized refinery plant to distribution sites, has increased the price of asphalt substantially. The use of the petroleum asphalt also generates hydrocarbon fumes, which irritate workers and create a nuisance for the surrounding community. Because of concerns over dependence on foreign oil, a high asphalt price and unstable supply, and air emissions, non-petroleum based bioasphalt made from renewable sources needs to be studied and developed. In this Phase II research, the bioasphalt production technology developed in Phase I will be scaled up to produce samples for evaluation in the field. The commercial viability of this technology will be demonstrated.

The broader impacts of this research are the use of a renewable and agricultural based product to reduce the use of petroleum asphalt, eliminate the odor and emissions associated with traditional petroleum asphalt, and improve the product performance.

United Science LLC

Phase II Award No.: 1058472

Award Amount: $516,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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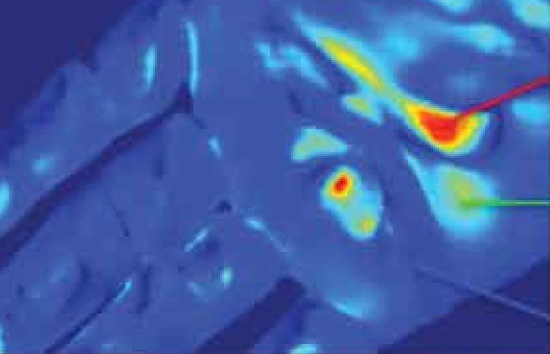
Program Director: Prakash Balan

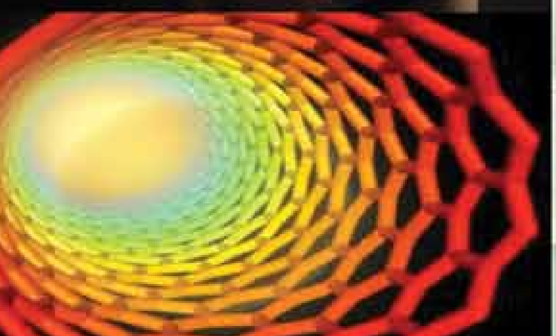
Sector: Environmental Technologies

STTR Phase II: Chemical Sensors for In Situ Monitoring of Collector Chemicals in Complex Copper Mine Effluents

This Small Business Technology Transfer (STTR) Phase II project addresses unmet analysis needs of froth flotation, a separations process widely used in the mining industry to separate worthless gangue from desired mineral particles. Phase I work has demonstrated the preparation of sensor membranes that permit the measurement of collector chemicals used in flotation suspensions. These sensors have been shown to be ideally suited for these measurements since they are not affected by turbidity, have high selectivity for collectors, and require no off-stream sample handling. The project will take advantage of the highly selective and fouling-resistant fluorous perfluoropolymer membranes introduced by the academic partner Phil Buhlmann. The Phase II project will optimize the sensing membrane characteristics to improve ion conduction and robustness. It will also assess the factors that affect sensor lifetime and engineer several prototypes to test at mining operations.

The broader impacts of this research are significant as it will enable the mining industry to be more sustainable in its approach to mineral recovery. Specifically, the research aims to significantly reduce the amount of toxic chemical waste associated with froth flotation and its inevitable environmental impact. The method has the potential of making the U.S. copper industry more competitive by reducing wasted collector while simultaneously improving mining sustainability by eliminating an estimated 24 tons of unnecessary chemical discharges. In addition to these benefits, the multidisciplinary aspects of this project will train students in synthetic and analytical techniques, involving concepts from chemistry, materials science, and engineering.






Electronics, Information & Communications Technologies

Education Applications
Electronic Components and Devices
Electronic Systems and Instruments
IT Applications

Agentsheets Inc.

Phase II Award No.: 1127398

Award Amount: $497,765.00

Start Date: August 15, 2011
End Date: July 31, 2013

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Sector: Education Applications

SBIR Phase II: A Collective Programming Environment for the Social Exploration of Computational Thinking through Games

This SBIR Phase II project seeks to build a system called CyberCollage as a Social Cyberlearning tool to support computational thinking in STEM education. CyberCollage will enable collective programming of educational games and STEM simulations through a unique combination of networked real-time collaboration mechanisms and Web-based social end-user programming. For example, multiple students can work together on a Frogger game. While one student may be programming the frog, a different student might be working on the turtles. Similarly, students can collaborate on science simulations that explore STEM related questions such as "can your frog live in my pond"? Phase I established technical feasibility, and showed that complex science simulations with tens of thousands of agents can both run efficiently and be created collaboratively by students working together, locally, in the same classroom, or separated by hundreds of miles. Phase II will establish CyberCollage as a scalable cloud-based implementation of a Social Cyberlearning tool, and will integrate embedded assessment mechanisms that make learning outcomes in computational thinking both measurable and predictable. These assessment mechanisms enable the investigation and study of computational thinking transfer evidence between game and STEM applications.

The 2010 PCAST report asserts that computational thinking is one of the fundamental concepts of networking and information technology. Fluency in computational thinking is needed to prepare today's students to be the next generation of innovators and professionals. The proposed combination of high accessibility through Web interfaces, increased motivational prospective through social interfaces, and tested curriculum integrated into required computer education middle school courses is likely to reach a vast audience and attract both women and underrepresented communities to information technology courses and fields. This reach is enhanced by the participation of the National Center of Women in Technology (NCWIT) and Google in the Phase II advisory board. Both organizations are already disseminating AgentSheets Inc. computational thinking resources, which is an extremely positive indicator of a high probability of broad impact and commercial success. The CyberCollage project has established access to disadvantaged communities that include inner city, remote rural, and Native American schools in Alaska, Colorado, South Dakota, Texas and Wyoming. These and other schools will serve as testbeds. A pledged investment by a third-party organization should establish a consumer-oriented extension of CyberCollage, making Social Cyberlearning of computational thinking relevant beyond its original scope of educational applications.

Barobo, Inc.

Phase II Award No.: 1152678

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Glenn H. Larsen

Sector: Education Applications

SBIR Phase II: Commercial Development of An Intelligent Modular Robot Platform for Research and Education

This Small Business Innovation Research (SBIR) Phase II project will study the feasibility for commercialization of an intelligent reconfigurable modular robot system called iMobot, which was originally developed at the University of California, Davis. Robotics has grown beyond automation to encompass systems that are self-reliant, reconfigurable, mobile, intelligent, and aware of their environment. iMobot has four degrees of freedom capable of full mobility and assembly into clusters. Because of its flexibility, modularity, and reconfigurability iMobot is an ideal platform for many research and teaching programs at colleges and universities. iMobot allows researchers to study artificial intelligence, swarm technology, robot collaboration, mobile networking, sensor fusion, gait simulation, and programming for re-configurability. Each module has am open architecture, with a processor capable of embedded Linux. Users can customize software and accessories for their specific needs. Proposed product feasibility research includes adaptable connectivity between modules, intelligent plug-and-play sensors, a robust and lightweight chassis, along with re-configurability. In this proposed Phase II project, a professional design team will develop necessary technology related to assembling into clusters including mechanical design, electrical interface, sensors, algorithms, control and control software and customer interface.

The broader impact/commercial potential of this project is great. This proposed project will be one of the first attempts to scale up an intelligent reconfigurable modular robot for commercial deployment. The initial market for iMobot will be for university research and teaching. With a standardized hardware base using an open architecture users will be able to more widely share their work with each other, and create a valuable open educational resource. The future release of different iMobot versions will be for life-saving rescue and search operations in the first responder system, and for K-12 education. Robotics is an interdisciplinary field. The unique full mobility and reconfigurability of iMobot are very appealing. Modules can be used alone or in collaboration with others, making it a flexible and scalable educational tool. Because of the homogeneous nature of modular robotics, the cost of manufacturing is reduced through production of a large volume of similar parts. By introducing students to interesting robotic projects with affordable hardware platforms, which involve a variety of math, physics, information technology, and engineering principles, we can excite their imagination and give them confidence to pursue STEM careers, especially for underrepresented and economically disadvantaged groups.

GOKNOW, INC

Phase II Award No.: 1058251

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Education Applications

SBIR Phase II: Understanding Science Processes Through Modeling and Animation: Efficiently Producing Low-Cost Software Tools for K-12

This Small Business Innovation Research (SBIR) Phase II project seeks to address a need in science education that is non-linearly becoming a serious problem. In general, educational technology has had a weak track record for positively impacting student understanding in the area of science. Research clearly suggests that students' use of science simulation programs does have a positive impact on their achievement and understanding. There is a dearth of such software, and the simulations that are available are 'heavyweight' - typically computationally, financially, curricularly, and cognitively demanding. The GoKnow AniModeler Software Factory seeks to demonstrate how to build a software factory that can deliver 36, lightweight science simulations for $1 per student per year! During our Phase I SBIR effort, the company will develop the object-oriented architecture underlying the AniModeler simulation engine. Their challenge in Phase II is to build a factory system that exploits that architecture such that the creation of a simulation program - an AniModeler - is done by a science educator without any programmer assistance and it outputs, automatically with versions for 5 operating systems. Supporting consumer functionality such as, mobile and lightweight applications are the future of software development.

The broader impact/commercial potential of this project addresses the full range of stakeholders: (1) In contrast to activities such as filling out worksheets, in using GoKnow's AniModelers in collaboration with their peers, students will see science as a social activity, sparked by a desire to understand how and why - not as a boring, solitary activity. Students will see science as a fun activity- successfully understanding how and why something works is a good - fun - feeling. (2) Teachers will see that lightweight, easy-to-learn-to-use, narrowly focused apps - just like the apps on their smartphones - are much easier to integrate into their existing curriculum when compared with typical educational software that is expensive and so profusely functional that it takes excessive class time to learn. (3) Educators will see that educational software doesn't necessarily need to cost an arm and a leg, and that Open Source is not the only alternative. (4) Science publishers will see educational software as positively contributing to the value of their print offerings - especially when they make money from the software. (5) And, last but surely not least, AniModelers can demonstrate to software developers that educational software can be a lucrative business!

Independence Science, LLC

Phase II Award No.: 1127412

Award Amount: $500,000.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Glenn H. Larsen

Sector: Education Applications

SBIR Phase II: Promoting STEM Education for Students Who are Blind or Print Disabled through the Development of the First Talking Pocket Size Scientific Data Collection Device

This SBIR Phase II project will produce technology to provide students with print disabilities (i.e., blindness, low vision, and learning disabilities that inhibit processing of text), who are commonly relegated to being passive observers in science classrooms, with the ability to directly participate in scientific data collection and analysis. Project objectives involve the development of non-visually-based technology for the collection and manipulation of data. The LabQuest, a popular scientific data-collection device used in many mainstream classrooms, is currently not accessible by students with print disabilities because it is operated through a text-rich, visual touch-screen menu. The objectives focus on making all features of the LabQuest accessible to students with print disabilities through fully incorporating text-to-speech software (resulting in an enhanced version of the Talking LabQuest developed in Phase I), non-visual collection and manipulation of data, the development of software interfaces between the Talking LabQuest and peripheral devices such as Braille note-takers (non-visually-based computerized devices frequently used by individuals with visual impairments for storing and manipulating data) and embossers for producing tactile graphs. All features, functions, and interfaces developed will be field tested by individuals with print disabilities for ease of operability. Based on Phase I successes, it is anticipated that individuals with print disabilities will be able to independently operate the proposed technology.

The commercial potential of this project concerns the inclusion in science, technology, engineering, and mathematics (STEM) education and professions of a population that has typically been disenfranchised from these fields. Persons with print disabilities are underrepresented in postsecondary studies and careers in STEM fields. Behavioral research suggests that self-belief in one's capacity to independently function in a particular field is an important determining factor in whether one chooses that field as a career path, and that hands-on experiences contribute to one's self-belief regarding the capacity to independently function. Data from Phase I are consistent with behavioral science research; specifically, it was demonstrated that the technology can be independently operated by students who are blind or visually impaired to collect and manipulate data. Phase I findings also indicated that these hands-on science experiences were associated with increased beliefs in students' capacity to independently function in science activities, increased inclination to consider postsecondary studies and careers in STEM, and improved academic outcomes. These data suggest that wide commercial availability of the proposed technology will help increase the representation of individuals with print disabilities in STEM studies and professions. Persons with print disabilities will be able to work independently in science classrooms and laboratories, and will be able to choose educational and career paths based on aptitude and interest. Additionally, because individuals with disabilities are frequently unemployed or underemployed and receive government assistance, their increased entry into STEM fields may reduce taxpayer burden.

Institute for Disabilities Research and Training, Inc.

Phase II Award No.: 1118610

Award Amount: $499,635.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Education Applications

SBIR Phase II: ASL Literacy Support System

This Small Business Innovation Research Phase II project will result in a robust assistive technology, cost-wise accessible to deaf individuals and their families/service providers, as well as businesses, which functions as: (1) An instructional tool to improve the literacy of deaf children and adults, and (2) A real-time translation device (i.e., between American Sign Language and English). The technology will accommodate a variety of input and output options: Input: (1) typing, (2) scanning, (3) screen text transfer, (4) sensor-enabled glove (the AcceleGlove), (5) 3-D camera, (6) speech recognition; and Output: (1) text, (2) sign graphics, (3) sign video clips, (4) speech. The Instant ASL Communication System, as it is called, has two access modes: DVD, Web or local server-based access. This hardware/software system also will enable the user to edit, print, select appropriate signs when more than one match the English word and vice versa, 'hide' signs when support is not wanted, retrieve sign graphics/videos through an index, and generate flashcards and sign/word matching worksheets. The product will include a translation lexicon of 24,000 English words/phrases and 8,000 signs. Many deaf children are challenged by reading since this process largely depends on auditory understanding. Teachers of the deaf frequently reinterpret text into ASL or enhance it with signs to render it more comprehensible to their students. Research has shown that incorporation of signs with text provides a multimodal approach to the development of early literacy skills that utilizes multiple intelligences and learning styles.

The broader impact/commercial potential of this project is largely reflected in its effect on the Deaf community and those who interact with them. ASL is a visual/gestural language distinct from English. Many deaf people who rely on sign language do not have good facility with English. Because English is an auditory mediated language that depends upon phonological code, reading achievement scores of deaf children usually fall far short of those found among hearing children of comparable abilities. An interesting aspect of the low reading skill levels displayed by deaf students is that while they may not understand a sentence in print, they may understand it perfectly presented in ASL. This product will be tremendously useful to teachers, business personnel, speech/language pathologists, etc. who have a need to support understanding of English text with ASL signs for purposes of literacy improvement, curriculum enhancement, or communication. This product will enable English users to type, scan text, or paste screens text and have output in text with ASL graphics and/or video support. Inversely, deaf users will be able to sign to it and obtain English text and audio output. As a server-based translation service, there will be considerable impact on the ability of deaf individuals to be integrated into society at large for employment, education, and social purposes. Improvements to the AcceleGlove will have implications to other fields of R&D, such as robotics, telemedicine, virtual reality, and defense. The gesture library will have utility to other gesture capture strategies (e.g., camera-based).

LectureTools Inc.

Phase II Award No.: 1058560

Award Amount: $445,701.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Sector: Education Applications

SBIR Phase II: LECTURETOOLS - An Integrated Textbook/ Learning Management System

This Small Business Innovation Research (SBIR) Phase II project aims to commercialize Lecturetools, an in-class integrated learning environment, to improve the quality of large, gateway higher education courses. Faced with the emerging online distance learning initiatives, traditional face-to-face oriented institutions are challenged to respond with innovative teaching approaches that validate their long established face-to-face teaching model. Many studies have shown poor student engagement and retention rates in traditional large-scale collegiate classrooms. At the same time, the model of using expensive, printed course textbooks is under great pressure - simply providing monolithic textbooks, printed or electronically, is not sufficient for successful student engagement or learning. An NSF panel considered the state of the college textbook and summarized that: The textbook of the future will be the organizing hub of an integrated learning environment where the student experience is key. The combination of advancements in web-based technology and the proliferation of laptops among students offer an opportunity to address both of these issues. LectureTools Inc. proposes to deliver an integrated learning environment that joins textbook materials with student response and inquiry, lecture delivery and student note-taking functionality.

The broader impact/commercial potential of this project results from the integration of multiple in-class learning tools strategically aimed at improving the educational opportunities in large gateway courses. These courses, with hundreds of students, too often offer few opportunities for active, engaging learning. Clicker companies offer multiple-choice student response systems, but few other question types, no direct access to textbook content and little, if any, functionality for student questioning or note taking. Course management systems (e.g. Blackboard, Moodle, Sakai) have been successful in organizing course assignments, grading and resource sharing that happen outside the classroom, but have not penetrated the in-class experience where LectureTools is uniquely targeted toward improving student engagement and learning. Publishing companies offer online access to textbooks, but not integrated with in-class activities. With the student response market projected to be $290M and the overall textbook market projected to be $6B by 2014, LectureTools is well positioned to capture a sizable proportion of these markets. The University of Michigan serves as a testbed and is offering a LectureTools to all courses starting in the fall, 2010. Contracts are already in place with major textbook publishers to supply the initial textbook content.

Syandus, Inc.

Phase II Award No.: 1058156

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Education Applications

SBIR Phase II: An Immersive 3D Simulator to Experientially Learn Immunobiology as a Networked System

This Small Business Innovation Research (SBIR) Phase II project will build on previous work to produce a transformative learning resource: a first-of-its-kind simulator that applies an innovative approach and advanced 3D interactive technology to learning the complex interrelationships in immunology. The company has used simulation-based learning technology platform to convey disease state concepts and clinical best practices to physicians for large pharmaceutical companies. This project extends this technology and approach to the study of immunology in higher education. Like many areas of science, immunobiology involves complex systems. The company is using an engineering paradigm to create a model immune system that is compartmentalized into elements that interact, forming a responsive whole. When this system is brought to life through interactivity and 3D visuals, students will experience how the immune system functions instead of reading about it. The company will work with educators and immunologists to build this simulator to fill recognized gaps in understanding this science. This Phase II project will result in a commercial version of the Immunobiology Simulator that will be marketed to colleges, universities, and medical schools with strategic science publishing partners.

The broader/commercial impact of this project will be the potential to create an Immunobiology Simulator that facilitates the comprehensive understanding of the immune system through direct experience of the interactions between its essential parts. This systems approach is a forward-thinking one that when combined with technology creates a new way to experience and learn immunology. Understanding the immune system is critical for advancing the battle against infectious diseases, autoimmune diseases, cancer, asthma, and many other disorders. Immunology is an essential component in sustaining our nations competitiveness in the life sciences. It is a growing element of biology, bioengineering, nursing, and medical school curricula, with 29 schools already offering a dedicated immunology major. The Immunobiology Simulator will be accessible over the Internet, providing broad distribution. With content oversight by accomplished immunologists and educators, it can also be a trusted remote resource to students at institutions that do not retain faculty members with this expertise. The firms systems approach can also be applied to virtually any complex scientific topic using the same Syandus platform and expertise, allowing them to expand the business and impact other areas in life science education.

The Athena Group Inc.

Phase II Award No.: 1127544

Award Amount: $470,572.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Sector: Education Applications

SBIR Phase II: Green Engineering Magnet (GEM) Project

This Small Business Innovation Research (SBIR) Phase II project proposes to research and develop the Green Engineering Magnet (GEM) Project in response to a national need to promote Science, Technology, Engineering, and Math (STEM) studies at the middle and elementary school levels. The GEM Project answers the question: *How can one actively moti-vate today's young scholars to pursue STEM studies in a meaningful and sustained manner?* The GEM Project uses the natural youthful attraction of green studies as a magnet to draw students into meaningful and relevant STEM studies. The Phase II GEM Project will frame an expanded list of Phase I STEM core topics and studies in the context of green engineering activities, providing students with authentic experiences that support the learning of STEM concepts presented in class. To achieve this goal, Athena will fuse together three powerful learning technologies beginning with immersive, high-value 3-D STEM simulators. Next, requisite data collection, display, and analysis activities will be channeled through virtual instrument portals that mirror real-world data collection activities. Lastly, software-enabled scenario-based learning motifs will be used to integrate, deliver, assess, and remediate content as authentic STEM activities. As a result, GEM students will engage in green engineering challenges by making observations, measurements, calculations, and choices based on sound science and economic and environmental costs, just like a green engineer.

The broader impact/commercial potential of this project is its support for middle school general science, earth science, and similar curricular offerings. In addition, GEM products will support teachers with activities having a green engineering emphasis. GEM Project users will benefit by becoming more capable and motivated in their in-class STEM academic studies, as well as being better prepared and interested in pursuing STEM careers and becoming more STEM-literate citizens.

Adicep Technologies

Phase II Award No.: 1152605

Award Amount: $499,999.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Compliant Nonlinear Quasi-Passive Orthotic Joint

This Small Business Innovation Research (SBIR) Phase II project aims to create a leg brace that addresses the underlying causes of mild/moderate walking dysfunction affecting 150 million people worldwide. Novel brace elements called Morphologically Switched Orthotic Joints combine field-adjustable, non-linear torsion springs with microprocessor controlled clutches to change the brace's mechanical state dynamically according to the user's gait. Internet updatable software, executing under a multi-processor, fault tolerant brace operating system, samples the brace's 40 sensors to monitor leg posture and activate clutch state transitions. Novel brace concepts include soft/flexible tissue interfaces that adapt to brace misalignment, a joint configuration that provides greater range of motion compared with existing braces, and a fitting scheme with potential for self-fitting capability. Three research objectives are planned: optimize the brace design for comfort level while minimizing interference with Activities of Daily Living (ADL); build/test five prototype braces; and conduct human subjects testing with disabled volunteers to assess brace safety and benefits. Primary biomechanical benefits include dynamically adapting to the user's leg strength to provide full support at all knee angles and reducing the total force across the knee joint by up to an order of magnitude during mobility activities.

The broader impact/commercial potential of this project stems from creating a brace that offers biomechanical benefits that substantially surpass those of existing devices without interfering with non-mobile ADL. Anticipated benefits include: allowing Knee Osteoarthritis (KOA) patients to walk with less pain; improving walking/stair-descent safety; adapting to the user's preferred step-length/walking-speed; reducing the effort needed to walk; and allowing a full day of mobile ADL (including a 20-mile walk) on a single battery charge. This will have a transformative effect on the existing leg brace market (120K offloading braces/yr alone) and improve Quality-of-Life for as much as 40% of the world's population suffering mobility dysfunction. The benefit for KOA patients includes a new treatment alternative for multicompartmental or obese KOA patients or for patients who cannot have knee replacement surgery. The benefit for walking/stair-descent safety includes potential for reducing the incidence of falls. Falling accounts for two thirds of accidental deaths and is the leading cause of restricted activity days amongst America's elderly; persons with leg weakness have a four- to fivefold increased risk for falls; directly addressing leg weakness therefore has potential to increase longevity and reduce healthcare spending.

Advanced Cooling Technologies, Inc.

Phase II Award No.: 1127293

Award Amount: $484,138.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Two-Phase Microchannel Heat Sink with Porous Layers Lining Channel Inner Walls

This Small Business Innovation Research (SBIR) Phase II project will develop an advanced heat sink and a two-phase pumped loop for cooling high power laser diodes and other high heat flux devices. An advanced coating will be applied to the heat sink to enhance the boiling process, suppress flow instabilities and improve overall heat sink performance. The objectives of this Phase II project are to: (1) develop and validate a two-phase heat sink model, (2) develop a system-level model for a two-phase pumped loop, (3) design and fabricate the heat sink and pumped loop system and (4) test the prototype loop in the laboratory and on an actual system. The key benefits of the technology include high heat flux capability and isothermal cooling. The system will be compact and designed such that it can be integrated with high heat flux components.

The broader impact/ commercial potential of this project will be to provide a new cooling solution for dissipating high heat fluxes in products used in the electronics and optoelectronics industries including compact high-power lasers. The technology developed will be capable of handling higher heat fluxes than those that can be managed with state-of-the-art, commercially available single-phase coolers. Moreover, the technology will not use refrigerants that have high Global Warming Potential. This program will also be performed in close collaboration with researchers at an academic institution and aide in the technical training of students in basic and applied research and new product development. The results of this study will be disseminated in the heat transfer community through conference presentations and journal publications.

Asius Technologies, LLC

Phase II Award No.: 1152467

Award Amount: $500,000.00

Start Date: May 1, 2012
End Date: April 30, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: New Technology for Coupling Sound to the Ear in Communications Devices

This Small Business Innovation Research (SBIR) Phase II project focuses on coupling sound to the human ear for communications devices (MP3, Bluetooth, hearing aids, headsets, earbuds) with unprecedented comfort, safety and audio quality. A chip-like device, the diaphonic valve, for harvesting energy from audio communications for the purpose of inflating a coupling device (balloon) in the user's ear has been demonstrated. This inflatable ear coupling mitigates excessive sound pressure levels that often occur within-ear listening devices, such as ear-buds and hearing aids, and which are a cause of audio fatigue and potential hearing damage. Diaphonic valve design has been dramatically improved making it smaller and more effective at pumping air. In this project, production of the critical diaphonic valve-chip component will be increased to a small scale manufacturing level. Additionally, the pressure and power utilization management hardware and algorithms to integrate the diaphonic valve and inflatable ear coupling (bubble) into commercial headsets, and hearing aids will be developed. Finally, work will be done on a non-inflatable ear couple technology, discovered during Phase I of this project, which also improves audio quality and hearing safety.

The broader impact/commercial potential of this project centers on revolutionary new person-to-audio couplings, based on an inflatable ear-piece, with applications in consumer audio, Bluetooth headsets, hearing aids, ear-buds, and headsets for professional communications (pilots, law enforcement, military, etc.). This technology has the potential to improve peoples lives by reducing listener fatigue and hearing damage in the population using in-ear devices, as well as making hearing aids more comfortable and better sounding for people who already have hearing loss. Published results from Phase I have shown how existing ear coupling approaches can produce dangerous sound pressures in the ear canal and how the technologies of this project allow ear couplings that alleviate this problem. The first embodiment of this new technology to the market will be a basic version applied to consumer headsets (ear-buds). From there, more complex applications, such as hearing aids, will be addressed. The success of this project will create engineering and business sector jobs as well as manufacturing jobs. The project also includes funding for a high school student or college undergraduate to participate in the research and development activities.

Baker-Calling

Phase II Award No.: 1127487

Award Amount: $496,373.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Electronic Components and Devices

STTR Phase II: High Performance Piezoelectric MEMS Microphones

This Small Business Technology Transfer (STTR) Phase II project will develop a microphone for the test and measurement (T&M) market that utilizes piezoelectric microelectromechanical systems (MEMS) technology. During Phase I of this project, feasibility was demonstrated by building and testing a microphone with the necessary performance for this market. Specifically, this microphone has a noise floor that is 10 times lower than any piezoelectric MEMS microphone previously demonstrated. The unique device modeling and optimization that allowed for this significant performance improvement enables a new class of microphones. During Phase II of this project, the commercialization effort will be accelerated by partnering with a production foundry to develop a fabrication process, enabling the mass fabrication of these parts. Successful completion of this task requires the repeatable fabrication in a production foundry with yield exceeding 90%. This Phase II project also seeks to further develop self-calibration capabilities, building on a unique aspect of these microphones demonstrated during Phase I. Successful completion of this task will result in a microphone capable of determining its own sensitivity to within 1 dB of that determined by standard calibration methods.

The broader impact/commercial potential of this project is significant due to the widespread use of microphones in today's markets. This microphone's unique combination of device simplicity and high performance enables a new class of microphones that fills the gap between extremely low-cost microphones used in consumer electronics applications and extremely high-cost microphones used in laboratories and test facilities. Through discussions with manufacturers and end-users of microphones and related systems, the company have determined that a wide range of applications would benefit from such a device. These microphones will significantly reduce the cost of complex T&M systems such as arrays that can cost more than $1M and improve the accuracy of equipment used by noise control engineers, work safety inspectors, police officers, and many others. Further, this microphone technology not only has the potential to impact the T&M market, but provides advantages for the hearing aid and consumer electronics markets as well. The total addressable market for this technology is more than $2.5B.

Bossa Nova Technologies LLC

Phase II Award No.: 1026525

Award Amount: $498,184.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: High Dynamic, Alignment Free Metrological Method for 3D Shape Measurement of Optical Surfaces Based on Polarization

This Small Business Innovation Research Phase II proposal aims at developing a new alignment-free metrological turn-key system dedicated to the measurement of optical surfaces with high measurement speed and high dynamic range. Next generation optical surfaces will need to be mass-produced with high departure from spherical shapes and high numerical aperture (Aspheric). Manufacturing these optical components is challenging because of today's limited metrology methods: contact sensors are too slow to be used in-process whereas interferometers and wavefront sensors have a small limited dynamic range and require careful alignment. The research objective is to design a prototype of a polarization based method and to evaluate its performances; speed, dynamic range, accuracy, insensitivity to alignment. The proposed approach combines an innovative polarization camera, a specific illumination, and a novel algorithm for automatic 3D shape extraction. The result of this research is to demonstrate that the proposed approach leads to very low sensitivity to alignment, fast measurement time, high dynamic range, and uncertainty smaller than current manufacturing tolerances. Preliminary simulations show that 2" diameter aspheric lens can be measured in 40 ms, with a resolution of 10,000 points, a dynamic range of 20 mm and an accuracy of 0.25 micron root-mean-square (RMS).

The broader impact/commercial potential of this project will address the growing manufacturing of aspheric optical components used for various applications: concentrating photovoltaics (CPV) for solar power generation, optical instruments, ophthalmic lenses and consumer electronics (cameras, phones). Controlling aspheric optical surfaces using current metrology tools is a time consuming process. Contact sensors are too slow and interferometers have tight alignment requirements and low dynamic range. The commercial potential of a system insensitive to alignment, performing fast measurements, with high dynamic range and good accuracy is extremely valuable for the following reasons. The system would allow mass production of high quality aspheric lenses with systematic inspection of each manufactured component. High numerical aperture lenses would also be measured easily in-process which will drastically increase productivity. This will translate into the faster deployment of cheaper, more efficient solar power production, lighter optical systems, and better corrected contact lenses. The present project will also have the broader impact of opening the door to a new kind of metrology based on polarization sensing, which could also be applied to many other industries such as plastics, steel, glass, automotive, robotics, surveillance and medical industries in the future.

Bridger Photonics, Inc.

Phase II Award No.: 1058583

Award Amount: $499,996.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Fast and Accurate Laser Distance Metrology

This Small Business Innovation Research (SBIR) Phase II project will enhance and optimize the Precision Distance Measurement system developed during the Phase I effort. The technology is based on innovative ultra-precise control of frequency-swept lasers to determine absolute object distances and thicknesses. The system is capable of distance and thickness measurements with <10-nanometer precisions, >1 kHz update rates, volume measurement coverage of 1 m3 (<10-micron precision), and measurement ranges >>1 meter. This combination of features is needed for industrial metrology, target identification, and precision surveying applications. During the Phase II effort, a prototype system will be constructed and used to perform targeted experiments based on identified OEM customer needs and industry technology gaps. The prototype will include Doppler compensation, a software interface, and will be fully configured and tested for both in-house and on-site testing. The prototype will then be used to perform critical in-house and on-site demonstrations driven by OEM customer needs, which include spatial multiplexing and galvo steering for rendering rapid 3D images, precise measurement of large-angle and diffusely scattering surfaces for precise measurement of aspheric lenses, oddly shaped objects, and rough surfaces, and precise measurement of meter-level displacements for CMM and gauge block calibration.

The broader impact/commercial potential of this project will initially be to improve manufacturing efficiency, quality, and production throughput. The measurement system uniquely combines extremely high precision (<10 nm) with the ability to measure over extremely large ranges (>>1 m). Due to this combination of performance and flexibility, coupled with demonstrated high update rates, the technology will enable increased production throughput in the manufacturing process and enable rapid absolute positioning and scanning measurements. The system will therefore enable considerable growth in an industry driven by advanced and more accurate inspection. The project will also lead to important societal benefits. For example, the technology holds promise for penetration into severely degraded visual environments caused by blowing sand and dust as well as into smoke or fog. It is anticipated that a variety of military and civilian applications would benefit from this capability including navigation, fire safety, and inspection systems. The benefits include saved lives and reduced property damage and more efficient search and rescue in burning buildings. Moreover, the system provides unique scientific opportunities such as enabling advanced space-based measurements by formation flying sparse apertures for the exploration of extra-solar planets and for atmospheric turbulence mitigation and high resolution imaging of the earth from space.

Chiaro Technologies LLC

Phase II Award No.: 1127545

Award Amount: $500,000.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Ultra-high-speed 3-D imaging

This Small Business Innovation Research (SBIR) Phase II project will produce a commercial prototype of a new 3-dimensional (3-D) imaging technology capable of measuring 3-D surface profiles up to five orders of magnitude faster than existing techniques. 3-D imaging technology is increasingly used for many applications, but current approaches have slow acquisition speeds and cannot accurately measure certain types of objects and scenes. The proposed technology will dramatically advance the state of the art in 3-D imaging speeds from a few Megapixel frames per second up to MHz frame rates without sacrificing metrological precision. At the same time, this approach enables surface profilometry of objects and scenes that are difficult or impossible to measure with existing techniques. The approach uses an innovative projection system to illuminate a scene with patterned light and simultaneously acquire multiple images of the scene. The 3-D image is reconstructed from the acquired images using novel, robust, pixel-independent algorithms that improve accuracy for diverse illumination, object reflectivity characteristics, and minimize the number of images required for an object-independent reconstruction. This Phase II program will build on successful Phase I feasibility demonstrations to produce a complete system suitable for beta deployment at a customer site.

The broader impact/commercial potential of this project will emerge when the technology is used in applications that boost productivity, increase security, improve health, and advance the progress of science. Commercialization will initially target the research market, where scientists and engineers studying mechanics, aerodynamics, robotics, and ballistics require the ability to image dynamic systems in 3-D to validate models, to provide feedback in the design process, and to verify performance of prototype designs. A second target market is manufacturing, where trends towards 100% testing and increased use of 3-D measurements will drive the need for high-speed 3-D imaging capability to improve efficiency, quality, and yield. Beyond these markets, the proposed technology could serve a variety of other unmet needs for high-speed 3-D imaging, such as facial recognition, haptic vision for the blind, robotic navigation and object recognition, entertainment, and others. Because the proposed technology offers unprecedented measurement capabilities in terms of speed, resolution, and versatility, it holds the potential to reveal new phenomena that were previously inaccessible, giving researchers a new tool for understanding our dynamic 3-D world.

Dot Metrics Technologies, Inc.

Phase II Award No.: 0848759
Phase IIB Award No.: 1231954

Award Amount: $1,062,163.00

Start Date: February 1, 2009
End Date: June 30, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Ultraviolet Germicidal Optical Flow Cell

This Small Innovation Research (SBIR) project will bring to market a low power, point of use (PoU) water disinfection system designed to retrofit into existing passive (non-germicidal) filtration systems. This project will use ultraviolet light emitting diodes (UV LEDs) along with a novel and proprietary flow cell design, resulting in PoU water disinfection. Current ultraviolet PoU water disinfection is accomplished using discharge lamps, which requires high voltage, ballasts, and a relatively large form factor. The use of UV LEDs instead of discharge lamps will allow the light sources to reside inside a smaller form factor, and to function at lower overall electrical power, without line voltage and ballasts. Furthermore, the proprietary optical design of the flow cell will improve upon conventional flow cells by maximizing the ultraviolet dose received by microorganisms in the water, and increasing their residence time in the flow cell.

Currently, there are no PoU systems employing UV LEDs as the germicidal source. If successful, the product developed under the phase II program will be the first of its kind and provide a point of entry for UV LEDs into the large PoU water sterilization market. The low power aspect and small form factor of the flow cell will make the system potentially suitable for battery operated field applications where line voltage is not available. Such applications may include military or medical field operations. Overall societal impact should be significant, particularly in markets outside the United States where there is increasing concern about water sterility.

Enervana Technologies LLC

Phase II Award No.: 1058523

Award Amount: $499,380.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Metal-based microchannel heat exchanger systems

This Small Business Innovation Research (SBIR) Phase II project aims to develop a compact, metal-based, recirculating liquid cooling system for next-generation electronic devices. The dramatic increase in computing power over several decades has been accompanied by an equally dramatic increase in the heat generated at the electronic module level. It is generally accepted that forced air cooling, the dominant cooling technology of today, will not be sufficient for high performance devices of tomorrow. Alternative cooling technologies with higher performance and lower area/volume footprint have become critical for better-performing computing devices. A significant market is expected for such advanced chip cooling technologies. Metal-based microchannel heat exchangers (MHEs) combine high heat flux removal capacity, low area/volume footprint, as well as high mechanical integrity, and constitute a leading technological contender for replacing forced air cooling. This project will focus on design and fabrication of metal-based MHEs and MHE assemblies as heat absorption and rejection modules with improved heat transfer performance, assembly of recirculating-liquid MHE systems, and benchmarking against competing technologies. The study on the design, fabrication, and heat transfer testing of metal-based MHEs will enhance scientific and technological understanding related to micromanufacturing, as well as microchannel liquid flow and heat transfer.

The broader impact/commercial potential of this project is tied into the ultimate project goal of incorporating liquid-based chip cooling technology with the best performance into next-generation desktop personal computers and other microelectronic and powerelectronic devices. The planned recirculating-liquid MHE chip cooling system is envisioned to become a critical enabler of higher performance and higher power electronic devices. A quick review of the progress in computing devices over the last few decades and the associated societal changes serves to convince that increased computing power in the hands of imaginative people can unleash unforeseen innovations. Successful execution of this project will push to the market place a product that can serve a catalytic role in such an innovation unleashing process. The target product will be marketed to computer original equipment manufacturers and is shown to enjoy performance and cost advantages over competing devices currently being contemplated. The project goal is to develop cost-effective manufacturing technologies to the point of production readiness. Successful execution of this project will help to establish the commercial viability of a technology-based manufacturing company with potential for positive economic impact and job creation.

Fairfield Crystal Technology, LLC

Phase II Award No.: 1026380

Award Amount: $516,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: A Novel Approach for Production of Freestanding GaN Wafers for III-Nitride Light Emitters and Detectors

This Small Business Innovation Research (SBIR) Phase II project is to demonstrate a novel technique for producing large-diameter freestanding GaN wafers and substrates. Despite the research efforts in the last decade, affordable GaN wafers and substrates of large diameters have not been widely available commercially, which hinders commercialization of high performance GaN-based devices. This Phase II project will demonstrate a unique approach to growth of GaN thick films and fabrication of freestanding GaN wafers and substrates with low densities of dislocations and low wafer bow/warp in an efficient manner. This Phase II research includes crystal growth of GaN thick films, fabrication of GaN wafers and substrates, and extensive characterization of GaN wafers. If this Phase II project is successful, high-quality freestanding GaN substrates of large diameters will become widely available commercially at an affordable price, which will enable volume production and commercialization of high-performance GaN-based light emitters and ultraviolet light detectors.

The broader impact/commercial potential of this project is in the areas of GaN-based light emitting diodes (LEDs), lasers, and ultraviolet (UV) light detectors. GaN-based blue and green high brightness LEDs hold a great promise for solid-state lighting applications because of their tremendous energy savings potential, long lifetime, compactness, and high energy efficiency. Solid-sate lighting will dramatically improve the nation's energy sustainability in the near future. In addition, freestanding GaN substrates are also needed for fabrication of variety of other high-performance semiconductor devices, such as blue laser diodes for data storage/displays, UV LEDs for water/air purification, high-power RF devices for wireless communication, high-power switching devices for harnessing renewable energies (e.g. wind, solar), and UV detectors for detection/analysis of chemical and biological agents for homeland security applications. Finally, this project will help create jobs in business sectors of energy conservation and renewable energies, and will increase competitiveness of US companies in these business sectors.

FiveFocal LLC

Phase II Award No.: 1152720

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Computational Low-cost Arrayed Infrared (CLAIR) Cameras

This Small Business Innovation Research (SBIR) Phase II project will develop a revolutionary approach to the lens and opto-mechanical design and fabrication process for long wave infrared (LWIR) imagers with the goal of reducing cost, size, and weight. To date, the high cost of sensors has made LWIR imagers accessible only in markets where performance -not cost - is the driving factor, allowing expensive and bulky optics to reign. New process improvements are significantly reducing the size and cost of LWIR microbolometer sensors, making optics the limiting factor for weight, size, and cost reduction. The research objectives are to extend the technology developed in Phase I and validate the final manufacturing and testing process for the optics and camera assembly to show that the final architecture can meet the market requirements for module volume, weight and price when scaled to high volume production. The development will scale the process to larger arrays and will take the necessary steps to evaluate the solutions mechanical reliability. The solution will be implemented and tested through arrangements with industry partners. The anticipated result is a demonstration of an LWIR camera that meets the needs of the infrared (IR) vision enhancement and thermography markets.

The broader impact/commercial potential of this project is to extend the sale of IR imagers into cost-sensitive commercial applications. Currently IR imagers are targeted for expensive military applications, but there is a large need for reduced cost systems in safety, security, and industrial markets where thermal imaging offers enhanced viewing over the visible spectrum. Thermal imagers provide visibility in complete darkness, which enables imaging in adverse conditions needed by automotive collision detection, search and rescue and security applications that require identification of humans in conditions of no light. In industrial use, LWIR thermography can improve energy efficiency by identifying thermal leaks and can predict imminent process faults. The impact to society is as ubiquitous as the commercial opportunities and constitutes an increase in emergency search effectiveness, city street safety, and energy conservation. The scientific and technological understanding cannot be understated: technological innovation occurs most rapidly near manufacturing capability. Already, labor costs are driving current labor-intensive IR lens fabrication overseas. The proposed innovations remove the labor-intensive component, bolstering the US as the dominant manufacturer in this emerging market while enhancing science in parallel process development, material property innovation, and IR sensor performance.

Gamma Dynamics LLC

Phase II Award No.: 1058302

Award Amount: $499,995.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Bistable Electrofluidic Device for High-Brightness Electronic Paper

This Small Business Innovation Research (SBIR) Phase II project will create electronic paper displays from a new e-paper technology that promises substantially improved black and white contrast, bright color images, multimedia/internet update speeds, and zero power image hold. The technology, an electrofluidic pixel that uses voltage to move a colored pigment in a fluid, is capable of achieving twice the reflectivity of existing e-paper solutions. This improvement in reflectivity enables the color saturation found in printed media. The multi-stable pixel designs demonstrated in the Phase I program make possible zero power images with grayscales. The Phase II research project will develop the technology for complete electronic paper displays incorporating this new pixel technology that are robust and manufacturable, and that achieve record reflectance (~ 70%). The first prototypes to be designed and created will be simple information content displays with simple electrical drive, such as electronic shelf labels. The later stage prototypes will be e-Reader displays with active matrix backplanes.

The broader impact/commercial potential of this project is the widespread replacement of paper-media with electronic paper, providing superior low power products to the current burgeoning market. In particular, the improvements demonstrated in this project enable saturated colors and multimedia "video" rates with a zero-power image hold, thereby overcoming performance barriers that have blocked low power color electronic books from entering the market. For example, this technology could replace a stack of textbooks with a single lightweight color multimedia tablet. The market opportunity is easily in excess of $10B, and will support numerous new U.S. jobs under a business model providing a sustainable economic benefit to the U.S.A. Multi-stable electrofluidic technology is also well suited for both small and large electronic signage applications.

Gamma Dynamics LLC

Phase II Award No.: 1127463

Award Amount: $449,569.00

Start Date: December 15, 2011
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Sector: Electronic Components and Devices

SBIR Phase II: Active Visible and Infrared Management for More Energy Efficient Buildings

This Small Business Innovation Research (SBIR) Phase II program will develop electrofluidic smart window modules with unique capabilities for managing infrared as well as visible light. As a result, these windows will better manage solar heat gain by switching between infrared transmittance and reflectivity. The ultimate objective is to develop skylights, windows, and roofs that adapt to seasonal, regional, and diurnal changes in solar flux and heating and cooling requirements. These window modules change the optical properties of surfaces by moving pigment from a small area reservoir to full surface coverage in a similar manner to the way squids change their skin color. The Phase I program developed pigmented fluids with engineering infrared responses, and demonstrated proof-of-concept functioning devices operating with these fluids. The Phase II project will develop the designs, processing strategies, and materials for full smart windows modules. Windows modules will then be built, measured, and directly compared with status quo windows. The innovation in this work is the development and realization of entirely new materials and devices for managing near-infrared light over a large surface area.

The broader impact/commercial potential of this smart window technology is empowering buildings to actively manage solar heat gain to improve energy efficiency, which is a truly green solution. U.S. building energy consumption (40% of total U.S. Energy Consumption) can be reduced significantly with smart windows and smart skylights that maximize sunlight for lighting, while effectively managing solar heat gain, including near-infrared energy. Current passive technologies for windows do not readily adapt to seasonal, regional, and diurnal changes in solar flux and heating and cooling requirements. By empowering buildings to adapt solar heat gain to daily local needs, U.S. energy consumption could be reduced by as much as one quadrillion BTU per year, while adding minimal cost to building infrastructure. The commercialization path for this technology is through the Advanced Flat Glass segment of the Flat Glass market. In addition, this program will enhance scientific innovation at the Ohio Center for Microfluidic Innovation, a cluster for commercializing micro/electrofluidic technology.

Innovega Inc.

Phase II Award No.: 1057840

Award Amount: $485,599.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Optic-On-Eye Virtual Reality Display

This Small Business Innovation Research (SBIR) Phase II project will extend the development of the contact-lens-enabled virtual reality display system demonstrated in Phase I. A key goal will be to advance the construction of the contact lenses to be ready for commercial market tests and OEM partner evaluations. Although the Phase I devices are fully functional and have validated the analytical predictions, they are not yet suitable for commercialization. The main deficiencies are the non-permeability of the polarization filter, the inadequacy of the joining adhesive, and the immaturity of the manufacturing processes. This project plans to develop a highly gas permeable polarizer using nano-imprinting onto gas permeable polymers. In addition, the contact lens construction techniques will be advanced in order to improve optical performance. A further goal is to develop prototype stereographic video eyewear to be used together with the contact lenses in support of clinical evaluations. Lastly, an IRB protocol will be developed and the contact lenses will be put through clinical trials. It is anticipated that all-day- wear contact lenses can be produced that will be able to meet FDA approval, and the performance advantages of this new display system can be evaluated during formal clinical tests.

The broader impact/commercial potential of this project will be a significant improvement in how mobile and immersive imagery is viewed. Today, mobile computing devices must present their information through small LCD panels, while immersive computing must settle for the limited fields of view available through flat panel monitors and TVs. Wearable electronic eyewear are available today that attempt to address these limitations, but they themselves suffer from limited fields of view and excess bulk. This SBIR research will address the remaining unresolved technical challenges in order to prepare this new display concept for commercialization. If successful, a meaningful enhancement of human vision will have been achieved by making it possible to directly view very near objects without impacting normal distance vision. These advancements will enable many new applications for wearable displays including augmented reality, highly immersive 3-D video, stylish mobile display eyewear, wearable surgical imaging devices, and even comfortable high quality electronic low vision aids for sufferers of macular degeneration and other vision disorders. Because mobile devices and home computers are so ubiquitous in our modern societies, the anticipated benefits of improving the man/machine interface through high quality virtual imagery eyewear should impact numerous markets and demographics.

Iris AO, Inc.

Phase II Award No.: 1152710

Award Amount: $447,831.00

Start Date: April 15, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: MEMS Deformable Mirrors for Laser Applications

This Small Business Innovation Research (SBIR) Phase II project will advance the state of the art in compact 360-degree camera systems, achieving sizes of about 1/8 of current systems, without compromising the quality or resolution of the optics. Convex mirror based optics has resulted in the realization of very high-resolution ultra-wide angle camera systems. A fundamental limitation in these systems has been the size of the optics in relation to the size of the imaging sensor. Mirror diameters in the range of 10 times the size of the sensor have been achieved. The objective of this research is to overcome the above limitation and achieve mirror diameters at the level of 3-5 times the size of the sensor, keeping ultra high resolution across the entire field of view. In this Phase II project, a miniature high-resolution 360-degree prototype system including optics and camera sensor will be built to demonstrate this capability.

The broader impact of this project will be will to increase the market reach of ultra-wide angle cameras for multiple applications, including video-conferencing, robotics and home surveillance. This new approach to designing optics will result in substantially reducing the form factor of high-resolution wide-angle optics. The high-resolution camera sensors available in the consumer market today can be better used in very small ultra-wide angle video cameras with the ability for multiple remote users to decide where they want to look independent of each other. This has the potential of transforming the market for pan-tilt-zoom cameras to "solid-state pan/tilt/zoom" cameras. The very low size, weight and power cameras that would result from this research can result in small wireless, battery powered systems that would increase the proliferation of cameras for a variety of different applications.

ISCA Technologies, Inc.

Phase II Award No.: 0823095
Phase IIB Award No.: 1105107

Award Amount: $948,148.00

Start Date: December 15, 2008
End Date: May 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Autonomous Sensor Network to Manage West Nile Virus Epidemics

This Small Business Innovation Research (SBIR) Phase II proposal seeks to develop an automated sensory system (AMSS) for gathering and processing of mosquitoes vectors of West-Nile-Virus-Fever (WNV). AMSS captures mosquitoes, macerates them with solvents, process the fluid using a sensory array, relays wirelessly the information to a centralized internet hub where data is hosted, managed, reports created and distributed. There are four main parts to the proposed AMSS: 1) Design and development of the robotic device that sucks and crushes the insect; 2) Design and development of the sensor array; 3) Development of methods to determine presence of WNV in the circulatory fluids of the insects; 4) Automated wireless system for transmitting data. The AMSS can also be decoupled from the mosquito-trap providing the user with a handheld-sensing-system to detect WNV in samples derived from vectors (e.g. mosquitoes) or hosts (e.g. humans, vertebrates in general). The proposed system can be potentially expanded for detecting other harmful pathogens and could be used by homeland security and public health agencies.

If successful, detection of the WNV-pathogen at a very early stage of its occurrence is of significant benefit to public health agencies and may allow for diversion of future epidemics. Early detection is the only form of early epidemic prevention. This project describes a disruptive concept to fill an enormous gap in vector-management, which now lacks technologies for speedy and effective data collection. WNV-detection-instruments are slow, expensive, bulky, require human interference and laboratory conditions with plenty of consumables and energy, and not amenable to unattended autonomous operation. Current detection procedures invariably fail to detect introduced pathogens before disease or epidemics become widespread. Vector-control personnel and epidemiologists rely on manual time consuming mosquito- vector management methods that often come too late to prevent epidemics and require expensive remedial actions, such as blanket spraying of insecticides on entire regions. Such mosquito management is inefficient, ecologically harmful and conducive to pesticide resistance. The proposed AMSS system will have significant impact in the detection of WNV-pathogens market, evaluated at $500M/yr. This will foster preventative rather than crisis or partially effective, remedial control actions. Implications can be made that this vector and disease management may be useful for bio-detection in the homeland-security, health-care, agroenvironmental field and food-safety markets, evaluated at $1.3B/yr.

IXM Corporation

Phase II Award No.: 1152523

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: A Cloud-Enabled Digital Art Service for User-Generated Music

This Small Business Innovation Research (SBIR) Phase II project will develop of a cloud-based, Internet service that facilitates a free and global exchange of user-generated music (UGM). A recent technological convergence of hardware, software, and the Internet has greatly reduced capital requirements for music production and distribution. The use of inexpensive production tools for music creation has reached a critical point and an opportunity now exists to facilitate a global, open, and free musical exchange directly between producer and consumer. Cloud computing offers the ability to facilitate this exchange in a highly scalable, capable, and cost efficient manner. Cloud computing also enables a cloud-based music consumption methodology which eliminates the consumer burdens of file management and backup while increasing accessibility.

The broader impact/commercial potential of this project is the greater technological understanding of the robustness and cost efficiencies of media-driven, cloud computing application deployments, and a potentially extreme disruption of current music markets and music consumption methods. Music is deeply rooted in human nature and throughout our life experience. Over the past century, the economic activity surrounding recorded music was concentrated in a small number of companies. This Phase II project supports an innovation that spreads this economic activity more equitably and provides the consumer music with cloud convenience, the producer direct access to consumers, affiliates with expanded markets, and society with democratized music.

Kapteyn-Murnane Labs Inc.

Phase II Award No.: 1152265

Award Amount: $497,303.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Development of a Commercial Two-Dimensional Infrared (2D IR) Spectrometer for Characterization of Chemical Systems

This Small Business Innovation Research (SBIR) Phase II project is to develop a prototype for a commercial two-dimensional infrared (2D IR) spectrometer and its associated mid-infrared laser system. One of the most exciting developments in the field of ultrafast spectroscopy in the last decade has been the invention of 2D IR spectroscopy. It is now being used to study problems in material science, chemical dynamics, electron transfer, biophysics, polymer structure, solar energy, analytical diagnostics and others. But while it is now recognized as a valuable research tool, it is difficult to implement since it is only being utilized by a relatively small group of ultrafast spectroscopists that specialize in infrared spectroscopy. The research objectives of this project are to design and develop a 2D IR spectrometer, including an efficient mid-infrared laser source, which requires no technical skills to operate. It will utilize mid-infrared pulse shaping, a newly designed optical parametric amplifier, and a mid-IR pump laser. The system will be mechanically robust and computer automated so that it will be used by 2D IR experts and non-experts alike.

The broader impact/commercial potential of this project is the development of a commercial 2D IR spectrometer that will be used in academic, government, and industrial research laboratories worldwide with applications spanning the biological, chemical and physical sciences. 2D IR spectroscopy provides structural and dynamical information that is difficult to obtain with other techniques, such as at inorganic/organic interfaces that are important in solar cell research or membrane proteins associated with pharmaceutical targets. There are more than 15,000 research laboratories worldwide that utilize infrared spectroscopy of some type, and 2000 labs that utilize ultrafast spectroscopy. Thus, the commercial potential is substantial. The development of this laser technology has important societal implications due to the wide range of scientific and industrial topics that this technology can be applied.

Levant Power Corporation

Phase II Award No.: 1127397

Award Amount: $500,000.00

Start Date: November 15, 2011
End Date: October 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Integrated Hydraulic Suspension Energy Recovery System for Heavy Vehicles

This Small Business Innovation Research (SBIR) Phase II project proposes to develop a fully functional turnkey regenerative semi-active shock absorber for heavy-duty transit buses and other commercial vehicles. An appreciable amount of energy is lost in a typical suspension as heat, especially in heavy vehicles. Existing technologies have been unable to efficiently capture this energy in a cost-effective manner. This project entails hydraulic and electronic model optimization, design of vehicle-ready prototypes, fabrication, lab testing, installation, and operational testing of a hydraulic adaptive damping energy harvesting system. The objective of the project is to demonstrate real-world benefits of an efficient, adjustable damping regenerative shock absorber on a transit bus in operation with a municipal transit agency. Emphasis will be on efficiency improvements, semi-active ride control, and application specific integration requirements to ensure seamless installation and operation. Work will culminate in a fully fielded pilot demonstration and quantification of regenerated energy (improved fuel efficiency) and ride improvement benefits using the regenerative semi-active shock absorber.

The broader impact/commercial potential of this project is significant if the challenges of inexpensively, reliably, and efficiently capturing suspension energy are overcome. The technology has the potential to save millions of dollars per year in fuel for large fleets, and significantly reduce carbon emissions in the United States and abroad. Effectively incorporating an aftermarket or OEM retrofit-able regenerative energy capture system may open doors to many new regenerative technologies in the transportation and automotive sector, facilitating significant reductions in waste energy. In addition, the research may lead to enabling technology for compact, sealed, and efficient hydraulic actuators and energy harvesters across several industrial applications. This may have applications in other fields such as off grid marine (hydrokinetic) energy, aerospace actuators, heavy machinery dampers, orthotics/prosthetics, and robotics.

Mad City Labs, Inc.

Phase II Award No.: 1152645

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Real-time Active Image Stabilization for Microscopy

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize an integrated system to actively stabilize an optical microscope to the precision required by today's cutting-edge imaging methods. Microscopy in the biological sciences is undergoing radical advancement on several fronts. "Super-Resolution" (SR) techniques circumvent the diffraction limit on resolution once thought to be insurmountable, and promise the ability to image the structures and processes of cell biology at the molecular level. This will usher in profound advancements in the understanding of the inner-workings of the cell. However, significant interrelated barriers remain in the path towards widespread use of SR techniques: (1) they are technically challenging and (2) expensive to implement; and (3) they place physical demands on the microscope platform it was not designed to meet. Foremost of these demands is that SR methods require control over the movement of the biological sample and the stability of the microscope system with nanometer precision. This commercialized integrated system is designed specifically to address these issues and remove these barriers. It uses a 3-axis, piezo-driven nanopositioning stage to control sample motion and actively maintains the stability of the system using the image as the reference point for this stability.

The broader impact/commercial potential of this project lies in making SR methods routinely useful to working biologists. These "game-changing" tools will advance our understanding of the molecular bases of disease pathologies, and enable far more exacting methods aimed at their treatments. The new insights will range from those in molecular virology and the development of safer and more effective vaccines, to the molecular mechanisms of neuronal signaling and learning and memory. In fact, it is hard to imagine an area of cell biology that will not be impacted by these emerging SR techniques. One of the pioneers of these methods has likened them to the Hubble telescope: they enable people to see things they simply could not see before. This analogy goes further: there is only one Hubble telescope, and currently very few SR-capable imaging systems, due to both the technical and economic barriers to their routine use. And while SR methods expose the physical limitations of microscopes in an acute manner, their stability and image acquisition requirements are not unique. Thus, this commercial system will be much more broadly useful: it will also enable focal-stability and molecular tracking at the nanometer-scale for any long-term imaging experiment.

Maine Manufacturing LLC

Phase II Award No.: 1152249

Award Amount: $499,980.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Novel Microarray Platforms For Detection Of Rare Molecules In Complex Mixtures

This Small Business Innovation Research (SBIR) Phase II project will provide an optimized composite polymer protein binding surface for proteomics applications. The new surface will be specifically designed for reverse phase protein microarrays to enable detection of rare molecules in complex biological mixtures. Discovery and quantification of rare molecules in complex mixtures is essential to improve the understanding of disease mechanism and progression, and responses to treatment regimes. Current surfaces used in these applications have properties that exhibit limited sensitivity of detection due to optical interferences, low protein binding and accumulation of nonspecific interactions. This project will optimize and introduce the application of a new track etched , nitrocellulose composite membrane for protein array applications. Manufacturing processes for the new composite will be developed to generate multiple forms of the composite to allow it to be incorporated into a variety of binding assay formats. This effort will also shed light on important properties for generating ultrasensitive binding surfaces. The result of this project will be an optimized composite membrane with characteristics and manufacturability suited for the most sensitive binding applications, such as reverse phase protein arrays. The platform initially will be optimized for fluorescent detection of rare molecules in complex cell lysates.

The broader impact/commercial potential of this project will be to provide a family of discovery and diagnostic tools that will expand the understanding, detection and treatment of human disease. The current focus in translational medicine for therapies in clinical trials is to identify expression patterns of proteins (biomarkers) in individual patients. These measurements allow the monitoring and understanding of individualized disease progression and responses to treatment. They will provide the data necessary to create targeted, personalized treatment regimens. Protein arrays have found utility over the past decade as research tools that provide multiplexed detection and quantification of protein expression. However, the full potential of these tools as diagnostic platforms that provide patient-specific information and guide drug treatment has not been realized due to insufficient binding capacity, limited dynamic range and poor sensitivity. This project defines a new composite surface that has a significant increase in both binding capacity and sensitivity when incorporated into multiplexed immunoassay systems. The composite can be included in a variety of platforms to enhance discovery and quantification of important markers on an individual scale as well as high throughput systems for broad diagnostic application.

Mezmeriz, Inc.

Phase II Award No.: 1058405

Award Amount: $515,662.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Next Generation Displays Based on Novel Carbon Fiber MEMS Micromirrors

This Small Business Innovation Research (SBIR) Phase II project is aimed at overcoming the small screen size limitations of mobile devices. The use of projection technology based on microelectromechanical systems (MEMS) micromirrors capable of scanning laser beams onto surfaces embedded within these devices offers a potential solution to the screen size problem. The end-goal of this project is the development of a tiny, energy efficient, low-cost, embeddable projection system capable of projecting large, high-resolution images at short distances from mobile devices. This effort will build off of work done in the Phase I project, in which a lab-scale functional prototype (a functional prototype has functionality but not scale or form-factor) of the system was built. This proposed effort will consist of two major research thrusts that are critical to the technology's success 1) Development of an illumination module with integrated intensity modulator, and 2) Development of an advanced, miniaturized, pico-projector prototype.

The broader impact/commercial potential of this project includes improving technology in the mobile device field. Business users and consumers are increasingly relying on the convenience of mobile devices as computing power and communication bandwidth improves. This market sector is increasing rapidly, and wireless mobile devices such as smart phones and netbooks are primary devices for computing and Internet access. However, the limitations of a sub-5" diagonal display have prevented mobile devices from achieving their full potential. The demand for ever smaller wireless devices (as witnessed by subsequent generations of the iPod) and the need for more screen real estate are in direct conflict. The capability of pico projectors to overcome screen-size limitations in mobile electronics devices, projecting a large image despite their small size, makes embedded pico projectors a perfect fit for space-constrained mobile devices. Through their ability to enlarge displays, embedded pico projectors can unlock the potential of the mobile device and make them more capable as primary computing and Internet-access platforms. This capability ensures this proposed technology will have high commercial demand for the extended future.

Nano Liquid Devices, Inc

Phase II Award No.: 1127563

Award Amount: $500,000.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Low Cost, High Bandwidth RF Switch

This Small Business Innovation Research (SBIR) Phase II project is aimed at developing Micro Metal Sphere (MMS) fabrication technology for Radio-Frequency (RF) Micro-Electro-Mechanical-System (MEMS) switch. The target applications are high-bandwidth RF switches and digitally-tunable RF modules that can be used in wireless communication systems including cell phone. The MMS technology is distinguished from conventional cantilever or bridge type MEMS switches in that it does not have suspended element and no restoring force is involved in the switch actuation. In conventional MEMS switches, the restoring force is often not able to overcome interfacial forces over time and causes the infamous stiction that leads to permanent failure. Since the MMS switch is designed to switch with free body, it does not suffer from mechanical wear and possibly free from stiction. In addition, the MMS technology can provide an extremely cost effective packaging solution replacing commonly used labor intensive and costly wafer level packaging technology. Since the MMS technology is integration-friendly with conventional silicon CMOS technology, it can be placed on top of any CMOS IC. Therefore, anticipated benefit with the MMS technology extends to size reduction. Also the MMS technology is expected to lower the activation voltage below 10V.

Nano Liquid Devices (NLD) is the first U.S. company invented and developed RF-MMS process and cost effective packaging technologies that will enable mobile phone makers to design smaller, lower-cost smart phones, entry-level handsets and other mobile devices, which will accelerate the convergence of cell phones and computing for the next wave of mobile innovations. NLD's technology will enable lower-cost smart phones, which will complement and replace notebook PCs among mobile business people and students who access data and communications anywhere for work, study, social networking, and entertainment. About 1.5 billion cell phones will be produced in 2011, of which 67% will be multiband handsets, so the global impact will be enormous. NLD's RF-MMS technology will enable faster, better cell phone communications integrating voice, text and video for the average user worldwide.

Nextval Inc.

Phase II Award No.: 1151957

Award Amount: $499,200.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Mass Spectrometry Imaging for High-Throughput Discovery of Enzyme Activity

This Small Business Innovation Research (SBIR) Phase II project will further develop and commercialize a groundbreaking technology for high-throughput cost-effective screening and analysis. This technology addresses the growing disparity between the ability to generate high-complexity chemical libraries with molecular genetics and combinatorial chemistry approaches, versus the ability to rapidly screen these libraries for high-value molecules. This new high-throughput screening product is a novel integration of an acoustic ejection device with chip-based mass spectrometry to produce mass readout microarrays that are analyzed in high-throughput with mass spectrometry imaging and computational algorithms. Phase II efforts will focus on a high-throughput screening product for cellulase enzyme discovery, a critical enzyme in the production of alternative fuels that is limited by optically based screens which often generate false leads. Importantly, this integrated high-throughput platform does not require sample labeling, is applicable to a broad range of chemical activities, and provides much more information from a single readout than current approaches. Phase II development will produce a commercial screening technology with these advantages and analysis throughput of 250,000 samples/week, while maintaining the flexibility for future applications in the industrial, pharmaceutical and diagnostic markets.

The broader impact/commercial potential of this project are cost-effective high-throughput discovery of new enzymes and molecules with enhanced or novel activities in the industrial, environmental, pharmaceutical or diagnostic markets. Also, the proposed technology enables entirely new types of high-throughput screens that are currently inaccessible with existing technologies. Most immediately this high-throughput screening product will be commercialized for application in the $1 billion industrial enzyme market with specific focus on one of the largest fractions of this market, the enzymes important for efficient and economically viable production of second-generation alternative fuels. Beyond the application to alternative fuels, Phase II development will produce a flexible discovery platform that can be expanded to numerous commercial markets. For example, the Phase II developments can also help develop new lower-cost therapeutics by reducing false leads and enable higher specificity diagnostics and testing by providing much more chemical information.

Photodigm, Inc.

Phase II Award No.: 0848649
Phase IIB Award No.: 1123575

Award Amount: $997,289.00

Start Date: February 1, 2009
End Date: April 30, 2013

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Program Director: Juan E. Figueroa

Sector: Electronic Components and Devices

STTR Phase II: High Performance Single Frequency Lasers

This Small Business Technology Transfer Program (STTR) Phase II project will enable a new generation of single-frequency semiconductor lasers to enable applications in displays, precision instruments and defense. Under the Phase I project the team developed industry-leading first generation lasers up to 200 mW. The initial customer feedback from a variety of applications has converged around the need for higher power under CW operating conditions and spectral stability under arbitrary modulation. Further feedback points to the need to address these requirements in a cost effective manner to ensure a competitive solution. The proposal outlines an innovative combination of materials engineering and monolithic device features to address these issues. The team proposes to fabricate and deliver for customer evaluation single frequency lasers operating (1) >500 mW under CW conditions or (2) meeting specified levels of spectral stability at pulse widths below 100 nsec with various duty cycles.

If successful this STTR Phase II project will enable a new generation of low cost single-frequency semiconductor lasers to enable applications in displays, precision instruments and defense. This work has a strong educational component with students in device and fabrication classes at SMU been exposed to and benefit from the proposed research. The devices, software and concepts developed on this STTR will educate students and visitors to the SMU photonics website, impact the world economy with laser instrumentation for medical and scientific applications, provide laser displays, and have a humanitarian contribution since these lasers are used in magnetometers to find mines and improvised explosive devices in war torn regions of the world.

ProSpect Photonics, Inc.

Phase II Award No.: 1026895

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Slitless, compact, low-cost, and multichannel volume holographic spectrometers

This Small Business Innovation Research (SBIR) Phase II project focuses on the commercialization of multichannel holographic spectrometers featured large operating bandwidth and fine spectral resolution. The proposed research is to develop a new platform for spectrometers using multiplexed cylindrical beam volume holograms (MCBVHs) as dispersive elements. Due to its unique characteristic, the MCBVH enables the design of two-dimensional (2D) spatial-spectral output patterns to significantly enhance the functionality of holographic spectrometers. A significant improvement of the operating bandwidth can be achieved without sacrificing spectral resolution while keeping all merits of a compact, lightweight, low-cost, reliable, and alignment robust holographic spectrometer. With the proposed multichannel spectrometer, several species of interest can be detected at one shot even though their spectrums are distributed in a very large spectral bandwidth. Due to the design flexibility of volume holograms, this technology enables the design of spectrometers with custom functionalities. Breaking the resolution-bandwidth trade-off of the conventional spectrometers with a holographic system that does not increase the complexity of the final product is the major breakthrough expected from this project. The expected outcome of this project will be a simplest yet highly functional spectrometer that can be designed to perform for technically any given application criteria.

The broader impact/commercial potential of this project is to provide an enabling technology for spectral sensor systems which offer great utility to the life science and medical markets. For high throughput screening, it is desired to have multiple channels read simultaneously on a test containing multiple sample sites. For fluorescence based tests, multiple fluorophores need to be quantified requiring more spectral information. Maintaining good sensitivity is still required in these applications for low concentration detection at a low cost and size demanded by these markets. The proposed multichannel spectrometer based on MCBVHs will have a broad range of applications in the fields of biochemistry, medicine, pharmaceuticals, industrial quality assurance, homeland security, mineralogy, and environmental monitoring. Moreover, the compact and lightweight nature of the proposed spectrometer makes it a perfect choice for handheld sensing devices that are of high current demand in several fields as mentioned above. The entire US market volume that can be covered by this technology has been $2.6B in 2005, with a prospected 7% growth rate through 2010. The use of sophisticated volume holograms with 2D spatial-spectral output patterns is an important enabling technology that can impact the design of custom multi-purpose spectrometers/sensors beyond the proposed functionalities.

Raydiance Incorporated

Phase II Award No.: 1026762

Award Amount: $499,457.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Novel Amplification Technology as a Path to Practical Application of USP Technology

This Small Business Innovation Research (SBIR) Phase I project makes significant advances in the field of photonics by developing a cutting-edge performance, cost effective and compact ultrafast laser light amplifier. The amplifier is a key element in generating this compelling form of light for revolutionary materials processing capabilities. Ultrafast lasers enable athermal ablation of nearly any material with micron-scale precision. Historically, ultrafast lasers have been confined to bulky, optical breadboard systems - ideal for academic environments but unsuitable for practical commercial applications owing to their ambient temperature sensitivity and tendency to drift out of alignment. The technology developed under this SBIR leverages novel laser amplifier glass material development to support a planar waveguide amplifier architecture. When combined with recent advances in fiber-optic ultrafast laser technology, the herein developed amplifier module will produce a high power, compact, and cost efficient ultrafast laser integrated system. In addition, the advances made in planar waveguides under this program have utility in compact, high performance long pulse and continuous wave lasers. The technology will advance the state of the art in photonics to yield cheap, efficient and rugged amplifier architectures which can be used in a variety of applications.

The broader impact/commercial potential of this project is to provide a pragmatic architecture for ultrafast lasers which enables discovery and the application of this light in the commercial marketplace. The inherent capability for the short bursts of light from ultrafast lasers to ablate any material, including novel glasses, noble metals, modern alloys, polymers, and other hard-to-machine materials will create substantial value by enabling a new generation of manufacturing techniques, products and services, and the businesses to drive these innovations. As a salient example, ultrafast lasers are capable of cutting and shaping bio-absorbable polymers, such as poly(lactic-co-glycolic acid) (PLGA), now in development for the next generation of cardiovascular stents. These slowly dissolve in the human body in order to avoid complications from restenosis. PLGA is extraordinarily difficult to machine with conventional lasers, due to meltingmor mechanical techniques, due to loss of structural integrity. Other examples include precise, efficient cutting of organic light emitting diode (OLED) substrates and precision thin film removal for high efficiency, large area solar panels. This technology will broadly impact business processes in multiple industries by advancing manufacturing fidelity-to-design and by making obsolete the incumbent defect removal methods such as hot acid etching.

RemoteReality Corporation

Phase II Award No.: 1152652

Award Amount: $487,554.00

Start Date: April 15, 2012
End Date: March 31, 2014

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Sector: Electronic Components and Devices

SBIR Phase II: Compact Ultra High Resolution 360 Degree Imaging System

This Small Business Innovation Research (SBIR) Phase II project will advance the state of the art in compact 360-degree camera systems, achieving sizes of about 1/8 of current systems, without compromising the quality or resolution of the optics. Convex mirror based optics has resulted in the realization of very high-resolution ultra-wide angle camera systems. A fundamental limitation in these systems has been the size of the optics in relation to the size of the imaging sensor. Mirror diameters in the range of 10 times the size of the sensor have been achieved. The objective of this research is to overcome the above limitation and achieve mirror diameters at the level of 3-5 times the size of the sensor, keeping ultra high resolution across the entire field of view. In this Phase II project, a miniature high-resolution 360-degree prototype system including optics and camera sensor will be built to demonstrate this capability.

The broader impact of this project will be will to increase the market reach of ultra-wide angle cameras for multiple applications, including video-conferencing, robotics and home surveillance. This new approach to designing optics will result in substantially reducing the form factor of high-resolution wide-angle optics. The high-resolution camera sensors available in the consumer market today can be better used in very small ultra-wide angle video cameras with the ability for multiple remote users to decide where they want to look independent of each other. This has the potential of transforming the market for pan-tilt-zoom cameras to "solid-state pan/tilt/zoom" cameras. The very low size, weight and power cameras that would result from this research can result in small wireless, battery powered systems that would increase the proliferation of cameras for a variety of different applications.

Sand 9, Inc.

Phase II Award No.: 1058078

Award Amount: $499,625.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Chip-Scale Micromechanical Gyroscope for Angular Roation Detection, Stability and Control

This Small Business Innovation Research (SBIR) Phase II project seeks to develop the next-generation chip-scale Micro-Electro-Mechanical Systems (MEMS) gyroscopes for use in wireless devices that now require unprecedented device performance with minimum possible footprint. For instance, inertial navigation and motion sensing in most cellular devices require gyroscopes with small size, high sensitivity and stability, low drift and low power consumption. Most MEMS gyroscopes used in consumer electronics and wireless devices do not yet meet all the criteria for large-scale deployment in the fastest growing segment of the market: handheld devices. Existing MEMS gyroscopes are fundamentally limited by their underlying technology - electrostatic actuation and detection of vibration and rotational amplitudes. For this research project, a new approach has been proposed to the engineering of MEMS gyroscopes that can detect 3-axis rotation with unprecedented sensitivity and stability with minimal footprint. The goals of the Phase II project are to (i) develop both 2-axis (x-y) and hybrid 3-axis (x-y, z) micromechanical gyroscopes; (ii) develop associated driving and sensing integrated circuits (IC); (iii) test and characterize the devices for optimal performance parameters; (iv) bond the IC wafer to the MEMS wafer with wafer-level packaging.

The broader impact/commercial potential of this project can lead to a revolution in the consumer wireless systems market with the standing promise of an integrated single-chip inertial sensor and timing device. Micromechanical gyroscopes have increasing relevance in inertial navigation systems and automotive applications. Beyond these applications which require devices with better sensitivity and stability, a host of new applications in consumer electronics have suddenly emerged. In particular, handheld devices such as cellular devices and GPS systems, and gaming consoles such as the Nintendo Wii now include miniature gyroscopes that must have extremely small footprint and consume very little power. The proposed approach lends itself to natural chip-scale integration with timing devices for future production of Timing and Inertial Motion-Sensing Units (TIMU), necessary for next generation inertial navigation. Another commercial impact will be on the chip manufacturing industry, as the integrated circuits (IC) wafers will be fabricated in the United States, in potentially high volumes. Sand 9 is involved in the proactive employment of women and minorities in its engineering team, towards its commitment to the creation of a diverse, next-generation workforce in the MEMS industry.

Shasta Crystals, Inc.

Phase II Award No.: 1026196

Award Amount: $509,883.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: Low Cost High Quality Nonlinear Optical Crystals for Laser Light Sources for Miniature Projectors

This Small Business Innovation Research (SBIR) Phase II project will demonstrate how to reduce the cost of manufacturing magnesium-doped lithium niobate (Mg:LiNbO3) crystals by more than an order of magnitude. Frequency-doubling crystals, such as Mg:LiNbO3 can convert 1064-nm light from an infrared laser to 532-nm (green) light. However, LiNbO3 crystals made by the conventional Czochralski technique typically cost $800 each, presenting an economic challenge for consumer applications. The approach is to grow crystals by the laser heated pedestal growth method with a novel afterheater and to pole them in situ. Phase II, enables the development of manufacturing capability for these crystals at a rate of 100,000 crystals per year at a cost of less than $22 each. In Phase III, The manufacturing capacity will be increased to 1,000,000 crystals per year and the manufacturing costs reduced below $8. The proposed cost reduction will enable manufacturers of picoprojectors to increase the brightness of their products by integrating lasers as the light sources instead of LEDs. The technical objectives are to optimize the density of Mg:LiNbO3 ceramic feedstock rods, to increase the manufacturing throughput by optimizing manufacturing yield and automating the growth apparatus.

The broader impact/commercial potential of this project is to enhance scientific and technical understanding by demonstrating a) a novel method of growing crystals with lower cost, higher speeds, and greater purity, and b) a way to pole LiNbO3 crystals in situ at lower cost. The project will generate a strong economic impact because many types of handheld consumer electronics devices (cell phones, PDAs, iPods, game terminals, etc.) contain digital data that require visual displays. Picoprojectors can display the content of handheld devices in large formats, but their LED illumination sources can't generate images with enough brightness to satisfy customers. Laser illumination sources can solve the brightness problem, but lasers are too expensive, primarily because of the cost of the frequency doubling crystals. This project will reduce the cost of these crystals and may thereby enable the picoprojector industry to realize its optimistic growth scenario ($3.6 billion in sales in 2014) rather than its conservative growth scenario ($901 million in sales in 2014). An intern, a science student who is a member of an under-represented group in the nation's science and engineering enterprise, will be hired to assist with Phase II research.

Silicon Audio, LLC

Phase II Award No.: 1026893

Award Amount: $490,012.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

SBIR Phase II: High Performance Directional MEMS Microphones for Communication Devices

This Small Business Innovation Research (SBIR) Phase II project will investigate a novel Micro-electro-mechanical systems (MEMS) microphone based on new design principles. By abandoning the design principles of traditional microphones (both MEMS and full-scale), a vastly superior acoustical design is being explored that has resulted in substantial improvements in fidelity and size reduction (15 dB signal to noise ration[SNR] improvement over existing commercial directional microphones, and roughly 100x smaller in volume). Furthermore, as demonstrated in Phase I, the microphones have an inherently directional response with the benefit of focusing on a speaker or event of interest while rejecting ambient background noise. These attributes make this innovation ideal for addressing an emerging need of high volume consumer communication device manufactures who are looking for acoustic sensing innovations with the unique combination of high performance + low manufacturing cost. The objective of this Phase II innovation is to continue prototyping efforts from Phase I to the point of pilot scale manufacture. This effort will entail finite element modeling and design optimization of the new device structure, fabrication of 2nd generation prototypes, and experimentation in collaboration with customers from several different microphone sectors including hearing aids and cellular phones.

The broader impact/commercial potential of this project is based on an enabling capability: the introduction of advanced audio features (e.g. directionality and high fidelity) into a suite of consumer communication devices. The primary customer focus for this innovation is high volume consumer communication device manufacturers. New applications on their horizon demand improvements in microphone component performance. There are presently several commercial suppliers of MEMS microphones. All use variations of a traditional microphone architecture which has proven incapable of addressing high SNR applications. Additional markets and applications for this innovation include acoustic instrumentation, performance audio, military and defense, intelligence gathering, speech recognition (e.g. in laptop computers), and hearing aids. Addressing hearing aid markets will have a societal impact as well, as patient satisfaction with hearing aid devices is presently very low. Innovations at the microphone and signal processing level have the potential to improve this greatly. The innovation is also expected to have other audiological applications including use in hearing health monitoring systems based on otoacoustic principles. Clinical tools and instruments based on this innovation will serve to enhance scientific and technological understanding in many fields of acoustics.

Spectral MD Inc

Phase II Award No.: 1058146

Award Amount: $468,914.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: 4-Dimensional Optical Tissue Imaging by Variable Digital Illumination

This Small Business Innovation Research (SBIR) Phase II project has as its main objective the development of a mobile physiological optical imaging hardware and software system to empower clinicians with the ability to deploy, capture, assess and distribute standards compliant image data characterizing deep wounds and cardiovascular conditions. The mobile system will allow clinicians to rapidly identify the presence of hidden wound conditions or problematic blood flow patterns thus allowing care facilities to provide more cost effective and informed care to their patients, while minimizing financial losses associated with wound related hospital acquired conditions. The intellectual merit of this project lies in its scientific pursuit to define, develop, and distribute a comprehensive systems platform that will significantly accelerate the deployment of suitable physiological optical imaging solutions into the market. The research includes linking illumination patterns to physiological conditions while implementing mapping transfer functions by way of digital signal processing. The research objectives include system definition, integration, algorithmic optimization, and clinical validations.

The broader impact/commercial potential of this project is to provide substantially affordable noninvasive imaging tools that may be used to assist in treatments that are more accessible to persons in remote areas or those having economic disadvantages. The portable device increases the ability of qualified clinicians to access patient wound care imaging diagnostics remotely, improving quality of care and accessibility to society. Broader commercial benefits include reductions in hospital visits and stays due to more thorough wound assessments and greater accessibility. The mobile system will enable care decisions that are more closely coupled with the state of the underlying tissue and related hemodynamics. It will also allow clinicians and patients to more effectively monitor the benefits of care decisions. The development of the novel and cost-effective optical system to facilitate the imaging of clinically and physiologically meaningful information will fill a void in the medical imaging industry for a point of care solution capable of providing quantitative visualization of physiological processes critical to wound care. The development of the mobile imaging technology will enhance scientific and technological understanding in the areas of optical-tissue image mapping, optoelectronic illumination systems, image processing, clinical applicability and real-time imaging scenarios.

Telescent Inc.

Phase II Award No.: 1057576

Award Amount: $423,660.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Optical Detectors Based on Transparent Microwires and Nanowires

This Small Business Innovation Research (SBIR) Phase II project will develop a new type of optical power monitor utilizing transparent microwires and nanowires patterned within a multi-layer anti-reflection coating. These "wires" are nanometer to micron wide traces defined within a transparent indium tin oxide (ITO) conductive layer. ITO typically absorbs 1 to 10% at visible and infrared wavelengths, depending on its thickness, and optical intensities greater than 1 mW/mm2 produce measureable localized heating. This temperature change induces a proportional resistance change that can be measured electronically. By inserting this detector in-line between fiber optic cables, the optical power of the internal signals can be measured without degrading the signal strength. Moreover, by reducing the dimensions of the trace to the nanometer scale, the detector also has the potential for high-speed operation with a bandwidth approaching GHz.

The broader impact/commercial potential of this project includes new optical monitoring applications that were previously impossible or impractical. In one example, inexpensive and miniature optical monitors can now be integrated within the hundreds of millions of fiber optic interconnects produced annually for fiber optic communication systems. Advanced self-monitoring and self-diagnosing communication network architectures can be developed for Fiber-to-the-Home networks and data centers by transparently measuring the optical power through fiber optic junctions. This technology promises to reduce the cost to measure power within optical fibers by two orders of magnitude, and has the potential to be mass-produced and even inkjet printed on flexible plastic film, window glass, solar panels, mirrors, displays, or even on curved substrates such as light bulbs and lenses.

TetraVue, Inc.

Phase II Award No.: 1058607

Award Amount: $500,000.00

Start Date: April 15, 2011
End Date: March 31, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Novel 3D Measurement and Imaging System

This Small Business Innovation Research (SBIR) Phase II project will build upon the success of Phase I which demonstrated the feasibility of a high resolution three-dimensional (3D) imaging system, based on a new technology that allows simultaneous 3D coordinate measurement and high resolution imagery using commercial off-the-shelf Charge-Coupled Device (CCD) or Complementary Metal Oxide Semiconductor (CMOS) sensors. Although stereoscopic 3D images and movies have existed for over 100 years, only recently have 3D laser scanners which can reach 1 mm accuracies for single points at ranges of tens of meters and triangulation systems which can achieve 0.1 mm accuracies at ranges up to 2 m been developed. These systems produce no images and must assemble a collection of single 3D points over time. Phase I demonstrated the ability to capture 3D images using a 6 megapixel focal plane array with sub-centimeter accuracy and identified areas where further improvement can be achieved. The Phase II effort will implement these improvements but will focus on the engineering, miniaturization and fabrication of a 3D camera prototype which has performance and a form-factor traceable to the alpha version of a commercial 3D survey-grade instrument.

The broader impact/commercial potential of this project will benefit multiple industries, from aerospace to industrial surveying to movie and game special effects, by providing the new capability to record and measure objects, motion and scenes in three dimensions with imagery and in real-time. Current technology, e.g. 3D laser scanners and motion capture systems, used to capture 3D coordinates of objects and surfaces is slow, difficult to use, and either can only be used on static objects or requires special suits and sound stages with limited resolution. Despite the difficulty and associated high cost, the value of 3D data is such that its use in 3D industrial survey has been growing at 40% per year, reaching $425M in 2008. The high resolution 3D camera technology subject of this SBIR has been demonstrated in Phase I to have the potential to increase the acquisition speed by 100X over current solutions while reducing total data collection and processing costs by 10X. While this speed and resolution improvement will have a large impact on current markets, the capability to have high resolution images of moving objects with 3D coordinate measurements at each pixel enables a large number of new markets such as 3D biometrics, security, cost-effective digital heritage preservation, real-time measurement of 3D trajectories and robotic vision.

Valencell Inc.

Phase II Award No.: 0848943
Phase IIB Award No.: 1047573

Award Amount: $1,015,972.00

Start Date: January 15, 2009
End Date: December 31, 2012

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Sector: Electronic Components and Devices

STTR Phase II: Monolithic Multiwavelength Blue-to-IR LED for Biomedical Diagnostics

This Small Business Technology Transfer (STTR) Phase II project, in collaboration with North Carolina State University, will develop and validate an innovative, mobile, multiwavelength pulse oximetry module for noninvasive health monitoring of various blood metabolites simultaneously in real time. At the heart of this pulse oximetry module will be a novel multiwavelength emitter having independent control of up to nine spectrally narrow wavelengths, ranging from blue to mid-IR, emitting from a single 1 mm2 LED die. In contrast with traditional dual-wavelength pulse oximetry, which measures oxygen saturation in the blood, the proposed multiwavelength LED will enable real-time analysis several additional metabolites critical to health monitoring via the same noninvasive paradigm. Furthermore, the individually controlled self-aligned wavelengths enable superior motion artifact cancellation, which is essential for eHealth and mobile fitness applications. The key objectives of this feasibility study are to: Demonstrate luminescent films with peak emissions from 400-1100 nm Integrate these films into a compact multiwavelength pulse oximetry module Optimize novel pulsing algorithms for multiwavelength pulse oximetry Validate the mobile multiwavelength pulse oximetry module in a lab setting The medical impact of dual-wavelength pulse oximetry, in both saving lives and reducing healthcare costs, has encouraged the development of broader platforms using additional optical wavelengths. Incorporating 3 or more independently controlled wavelengths has been shown to enable the real-time monitoring of multiple health factors while further reducing readout errors - thus saving more lives. Beyond blood oxygen monitoring, a real-time noninvasive assessment of renal and hepatic health can be realized by integrating several wavelengths in the same clinically accepted pulse oximetry paradigm. Though multispectral pulse oximetry systems incorporating several optical sources have been successfully demonstrated by physicians and industry leaders, incorporating multiple LEDs (made from dissimilar semiconductors) has led to costly reliability errors and even product recalls. If successful the proposed mobile, multiwavelength single-die approach surmounts these limitations by providing independent control of several wavelengths from a single, self-aligned, compact LED. Integrating these advanced, cost-effective optical sources into traditional pulse oximetry opens up new markets in noninvasive metabolic monitoring for clinical research, paramedics, physical therapists, drug discovery, consumer eHealth markets, and home healthcare. As a spectroscopic source, other applications include air-quality/pollution monitoring and agricultural/industrial controls.

Visualyze Technologies, Inc.

Phase II Award No.: 1058159

Award Amount: $492,118.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Wavefront Microscopy: A low-Cost Implementation of High-Quality Microscopic Phase Imaging for Bioscience Teaching and Training

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize a revolutionary method to convert standard low-cost optical microscopes into high-performance, low-cost imaging instruments for biological research and education. The technology uses a specialized image sensor to render transparent biological samples visible at optical wavelengths without staining techniques or expensive optical microscope elements requiring extensive training. In addition, the technique naturally deconvolves amplitude and phase, enabling better interpretation of "dark spots". This project represents a major application of silicon photonics, exploiting the vast semiconductor fabrication infrastructure for novel optics manufacturing techniques. In addition, this proposal addresses selected performance improvements, such as noise reduction via an added cooling unit and enlarging the field of view through denser pixel arrays. When fitted to a standard laboratory microscope, our novel sensor camera offers the capability to produce high-quality, real-time in vivo microscopic phase imaging at a significantly lower cost.

The broader impact/commercial potential of this project is to enable high-quality, real-time microscopic images of in vivo biological samples. Our business strategy and product plan addresses two potential marketplaces: 1) Secondary schools, college teaching laboratories, and other educational settings; and 2) Academic and industrial research laboratories. Our market penetration strategy provides for educational microscope users to access our novel imaging capabilities at significantly reduced cost, revolutionizing bioscience teaching and training by rendering transparent samples visible in real time and enabling new curricula with a higher experimental component. Academic and industrial researchers also can exploit our innovative technology, using it for better imaging capabilities and removing ambiguities in dark spot interpretation. Our camera is entirely compatible with standard microscopes, enabling retrofits without technical challenges or the need for advanced training; it is also useful for observation of cultures in standard culture dishes, unlike competing techniques. This technology lies at the cutting edge of silicon photonics applications for biotechnology and represents an exciting new way to leverage silicon manufacturing economics for imaging applications.

Vortex Hydro Energy LLC

Phase II Award No.: 1026367

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Components and Devices

STTR Phase II: Havesting Hydrokinetic Energy Using Vortex Induced Vibration and Fish Biomimetics

This Small Business Technology Transfer (STTR) Phase II project will advance the development and prototype testing necessary to transition an innovative large scale generating system from concept to commercialization. The underwater energy generation system is based on the naturally occurring phenomenon of vortex induced vibration (VIV). This device harvests hydrokinetic energy via a system of cylinders that oscillate due to water currents at velocities as low as 2-3 knots (water turbines require 5-7 knots). This system captures energy from water currents - unlike hydroelectric power there are no dams or turbines. The proposed research and development includes: (a) Application of Passive Turbulence Control (PTC) to enhance the hydrodynamic effect of VIV and increase hydrokinetic harvested energy for large scale cylinders; (b) Identification of optimal cylinder spacing as a result of using PTC; (c) Installation of a large 4-cylinder module in the St. Clair River in Port Huron, MI; (d) Classification and research of appropriate materials to extend period between maintenance cycles in harsh marine environments.

The broader impact/commercial potential of this project is that it taps into a vast new source of clean and renewable energy - water currents as slow as 2 to 3 knots. Currently, there are only pilot devices for harnessing horizontal hydrokinetic energy (currents, tides). All devices considered are conventional propeller/turbines that target speeds around 5-7 knots (only seven locations with these conditions exist in the US). The vast majority of river/ocean currents in the United States are slower than 3 knots. This leaves the vast majority of rivers and bodies of water in the country untapped for power generation. Renewable energy generation is one of today's most challenging global dilemmas. The energy crisis requires tapping into every source of energy and developing every technology that can generate energy at a competitive cost within the next 50 years. Development of this technology will bolster domestic energy security and mitigate global climate change. There are numerous commercial and military applications from small scale (1-5kW) to large scale (100MW). Applications span from small portable devices, to direct water pumping for irrigation, direct pumping for desalination, off-shore stations, idle ships, coastal naval bases, etc.

Zomega Terahertz Corporation

Phase II Award No.: 0848811
Phase IIB Award No.: 1135349

Award Amount: $990,000.00

Start Date: January 15, 2009
End Date: April 30, 2013

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Sector: Electronic Components and Devices

SBIR Phase II: Compact THz-ABCD Spectrometer

This Small Business Innovation Research Phase II project proposes to develop a compact THz-ABCD (air-biased coherent- detection). spectrometer based on a new technique for generating and measuring ultra-broadband THz waves utilizing a laser induced plasma in ambient air and selected gases. A focused optical pulse with >100 uJ pulse energy and <100 femtosecond pulse duration in gas creates a plasma (ionized gas molecules), which produces very intense (>300 kV/cm), highly-directional (<6 degree), and ultra-broadband (10% bandwidth from 0.1 to 10 THz) THz waves in the far field. Through the reciprocal process, air or selected gases also serve as an ultra-broadband sensor of pulsed THz waves through air-biased coherent- detection (ABCD).The region of the electromagnetic spectrum from 0.3 to 10 THz (1 mm - 30 um in wavelength) is now a frontier area for research in physics, chemistry, biology, materials science and medicine. Recently, the observations of THz wave generation and detection in the laser induced atmospheric plasma provide new method in remote sensing and spectroscopy. The use of air as THz wave emitter and sensor provides unprecedented bandwidth (spectral range of 0.1 to 30 THz), sensitivity (heterodyne method), and spectral resolution (<MHz) which were previously considered impossible to achieve simultaneously. In addition, this technique produces THz electric field strengths approaching 1 MV/cm, unlocking the potential for nonlinear THz spectroscopy previously inaccessible by conventional optics lab facilities.

Recent advances in the use of air/gases to emit, control, enhance, and measure broadband THz waves open up a range of research opportunities. Applications including nondestructive testing, tomographic imaging, label-free genetic analysis, cellular level imaging, explosives detection, and chemical/biological sensing have thrust THz research, from relative obscurity, to new heights. The proposed development of a compact THz ABCD spectrometer will provide a key enabling technology for interdisciplinary research. In addition it will advance numerous sensing and imaging concepts in the THz frequency range, with an immediate impact on non-destructive spectroscopic analysis (eg: pharmaceutical R&D, materials research), a near-term application (3 to 5 years) for homeland security and a longer-term interest (5 to 10 years) in the biomedical sector. If successful the outcome of this project will make significant contributions to academic and governmental laboratory collaboration, student education, and instrumentation development.

AccuStrata Incorporated

Phase II Award No.: 1026370

Award Amount: $432,016.00

Start Date: October 1, 2010
End Date: September 30, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Real Time Optical Control System for Thin Film Solar Cell Manufacturing

This Small Business Innovation Research (SBIR) Phase II project is directed at developing a real time process control system for improving manufacturing of thin film products such as thin film solar panels, solid state lighting, touch screen displays, optics and telecommunications. Photovoltaics are a vital component of the renewable energy mix but they need to be more efficient to be competitive against existing fossil fuel approaches. The system will be able to dynamically control and correct the film deposition process in order to keep each product within its targeted specification, reducing and even eliminating rejects. It allows manufacturing of more consistent and uniform solar panels resulting in higher solar conversion efficiency, reduced cost and increased manufacturing yield. The objective of this Phase II is to further develop and improve the prototype system developed under Phase I and IB and validate it for two most common thin film solar panel manufacturing configurations. This project will complete the hardware / software development and validation for monitoring film growth for amorphous silicon solar panel manufacturing. Phase II will remove technical risk allowing fast commercialization of the monitoring system. Additional development will be performed to finalize the control component of the system.

The commercial potential of this project is to advance the scientific understanding of how thin films grow during deposition. It will help thin film solar panel manufacturers to develop higher quality products. The system will improve production accuracy, reduce production flaws and make the manufacturing process less susceptible to process parameter drifts and errors,especially for advanced thin-film products. The commercial impact of the project is that manufacturers will (i) increase solar panel efficiency and manufacturing yield, (ii) reduce manufacturing cost, and (iii) increase revenue and profit. The proposed technology provides an innovative platform solution that can be further improved in order to achieve waste-free thin film manufacturing with little human interaction. This system, if adopted by only 30% of the thin film manufacturers will result in roughly $1 billion in savings by 2015. The societal impact of the project is to help make solar panels a competitive source of energy against existing fossil fuel approaches. The system will allow manufacturers to meet the market demand for lower cost solar products which will accelerate PV adoption worldwide thus helping to reduce global warming and reduce our dependence on oil.

Active Spectrum Inc.

Phase II Award No.: 1058145

Award Amount: $516,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Airborne Soot Sensor for Improving Fuel Efficiency and Reducing Pollutants

This Small Business Innovation Research Phase II project will result in the development of a miniature airborne soot sensor for automotive diesel engine exhaust sensing applications. Current government regulations mandate that by 2012, all diesel vehicles sold in the United States will be equipped with onboard NOx and airborne particulate matter sensors. The proposed particulate matter sensor is based on the principle of electron spin resonance (ESR) spectroscopy. This sensor technology will be miniaturized and hardened for use in an automotive application for airborne soot sensing. Design changes intended to meet aggressive cost-reduction goals are an important feature of the project. The end result will be an automotive-grade, low-cost airborne soot sensor that can ensure end-users' compliance with new diesel engine emissions standards.

The broader impact/commercial potential of this project is a reduction in airborne particulate matter emissions. Airborne particulate matter has been identified by the US government as one of six criteria pollutants with potentially serious health and environmental effects. Among the largest sources of airborne particulate matter (PM) are diesel vehicles and power plants. We propose a new, low-cost and highly specific airborne soot sensor based on a miniature electron spin resonance sensor technology. The upcoming government regulations for onboard vehicle diagnostics, combined with similar regulations abroad create a market for approximately 6.3 million airborne soot sensors per year worldwide. It is expected that the worldwide market size for onboard airborne soot sensors will grow to approximately $350M/year as a result of upcoming regulatory changes.

Affectiva

Phase II Award No.: 1152261

Award Amount: $499,999.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Cloud-Enabled Analysis Of Facial Affect

This Small Business Innovation Research (SBIR) Phase II project will commercialize the world's first cloud-based emotion measurement platform. Today, the majority of market research is expensive and slow, relying either on subjective self-reports or costly, obtrusive lab-based technologies. The proposed emotion measurement platform aims to democratize market research by translating nonverbal facial expressions into intuitive emotional insights. It also drives down research costs and improves market reach through the use of widely available webcams as the means to record faces. This platform enables businesses of any size to capture consumer's emotional reactions as they engage with their brands, particularly in the areas of advertising, product design and packaging. For example, brand managers, marketers and agencies can optimize ad effectiveness by evaluating viewers' tacit, moment-by-moment emotional response, in real-time over the web, and through the platform's emotion norms database. The technical objectives of this project focus on implementing automated facial analysis as a scalable cloud-based software-as-a-service platform, building the emotion norms database, and deploying the platform with leading market research partners.

The broader impact/commercial potential of this project is to disrupt longstanding methods in market research by objectively measuring people's emotional experiences a) unobtrusively b) in real-time, c) at scale, and d) cost-effectively. While this differentiated emotion measurement technology can be leveraged in several target markets, the company's initial focus is on measuring advertising effectiveness and media research to deliver actionable insights to leading media and market research companies. In addition, the proposed cloud-based emotion measurement platform has the potential to significantly accelerate research in behavioral sciences by enabling the crowd sourcing of huge corpuses of naturalistic and spontaneous responses to a wide range of interactions and experiences from online learning to social gaming. It also allows entirely new research questions to be asked, and tackled with ecologically valid data, such as whether individuals on the autism spectrum respond differently to content. Thus, in line with the origins of this technology, our product accelerates psychological and clinical research on social-emotional intelligence. The long-term vision for this software as a service platform is to 'emotion-enable' the Internet, giving consumers and organizations the ability to add emotion context to all online interactions.

Aquatic Sensor Network Technology LLC

Phase II Award No.: 1026790

Award Amount: $499,720.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Developing a Real-time High-data-rate Multicarrier Underwater Acoustic Modem

This Small Business Innovation Research (SBIR) Phase II project aims to develop a real-time high-data-rate multicarrier underwater acoustic modem for aquatic applications. The modem to be developed will achieve a data rate that is more than one order of magnitude higher than all competing commercial products in challenging shallow water environments. It will have robust error performance in the presence of impulse-like noise and undesired disruptions. In addition, the modem will be power efficient to sustain long operation time, have a user-friendly interface, and maintain an easily-extendable architecture to facilitate advanced networking functionalities. Bringing the advanced multicarrier technology into the underwater modem market, this project solves one long-standing problem in the field, i.e., making multicarrier modulation work in underwater channels (earlier attempts all had only limited success). With one order of magnitude data rate increase, this project will significantly advance the state-of-the-art in underwater telemetry.

The broader impact/commercial potential of this project is that the high-data-rate multicarrier underwater acoustic modem will significantly improve the operation of a wide range of aquatic applications, such as underwater environmental observation for scientific exploration, commercial exploitation, and coastline-protection/target-detection in military or anti-terrorism. It will also directly facilitate the development of emerging and fast-developing underwater wireless sensor networks and autonomous underwater vehicle networks. The significantly enhanced monitoring capability of aquatic environments will help us better understand and exploit the earth, preserve and protect it for our future generations. As more than 85% of underwater applications are envisioned to be in shallow water, this project will have enormous commercial impact in multiple market sectors including environment, energy, fishing, tourism, and national defense, etc.

Artaic LLC

Phase II Award No.: 1152564

Award Amount: $500,000.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Computer-Aided Mosaic Design and Construction

This Small Business Innovation Research (SBIR) Phase II project will develop a computer-aided mosaic design and robotic assembly system for automation of a centuries-old manual process. Despite their prominence in art and architecture, mosaics are arduous to design and assemble. Labor-intensive methods have stubbornly resisted automation, adding considerable cost and delay to projects. Artaic's Phase I research proved feasibility of computer-aided design software to create renderings and digital blueprints of artisanal mosaics by introducing a streamlined, procedural workflow for tile layout that closely mimicked the workflow of mosaic artists, and did so over 10x faster than manual methods. The goal of the Phase II research is to demonstrate the speed, effectiveness, utility, and artistic quality of this mosaic design and robotic assembly system. The key Phase II objectives are to: (1) demonstrate a prototype artisanal mosaic design system and; (2) demonstrate a robotic mosaic production system, that will be: (3) validated for accuracy, speed, and quality through user assessment, and; (4) evaluated for economic and commercial potential. Anticipated technical results will enable a revolutionary advancement from manual to automated processes in mosaic design and production, comparable to the displacement of film by digital camera technology.

The broader impact/commercial potential of this project lies in art, design, construction, and architecture. Software and robotic automation will lower the cost of mosaics and increase its traditional societal impact of adorning public, commercial, and residential spaces. Artists, designers, and builders will have a significantly faster method to produce artisanal mosaics without the high cost and time associated with manual design and production. The efficiencies made possible by this proposed computer-aided mosaic design and manufacturing system will enable Artaic to expand into the global multi-billion dollar tile market and develop a domestic workforce to compete against global manufacturers of handcrafted mosaic artwork. Additionally, the computational demands of the rendering algorithms developed during Phase II will give impetus to further development of advanced GPUs and CPUs -- with companies such as Intel, Nvidia, and AMD providing solutions for increasingly more advanced rendering algorithms. Perhaps the most significant societal benefit from the development of this technology is its potential to make artisanal mosaic design and production accessible and affordable to the general public, and because this research enables any Photoshop artist to become a mosaic artist, it also hold significant promise as an educational tool in our nation's schools.

Barrett Technology Inc

Phase II Award No.: 0823008
Phase IIB Award No.: 1105104

Award Amount: $1,032,000.00

Start Date: November 1, 2008
End Date: April 30, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Low-Cost Ultra-Efficient 50-gm, 300-W Servoelectronics Module with Integral Sensors

This Small Business Innovation Research (SBIR) Phase-II research project aims to cut the manufacturing cost of an innovative power-efficient ultra-miniature, brushless-servo-electronics module from $1,000 to $100. The module integrates all rotor-position sensing, vector-based commutation, controls, and power supplies needed to drive high-performance brushless servomotors rated up to 300 W (Root Mean Square) and 2 KW (peak) into a single 50-gram module not much bigger than a bottle cap. The cost reduction relies on a set of innovations led by replacement of laser optics used for rotor-position sensing with an array of magnetic field sensors measuring a calibrated target magnet. Phase I demonstrated that well-placed shielding enables high precision and excellent commutation performance even in the proximity of stray fields produced by high switched currents and spinning rotor magnets located in the motor body only millimeters from the sensor array.

This servo-electronics module fits the definition of disruptive technology for entrenched players, such as Danaher/Kollmorgen, Siemens, Fanuc, and Yaskawa, while it will enable scores of original equipment manufacturers (OEMs) to improve the performance, compactness, power efficiency, and reliability of their machines at competitive prices. As machines become more intelligent through embedded processing and sensor fusion it will improve not only industrial productivity, but quality of life as society ages. While embedded processors and MEMS-based sensors have become tiny, highly effective, and affordable, similar improvements in servomotors have evolved more slowly. At fractional-horsepower levels the power electronics contribute significantly to total motor-system bulk and complexity. Providing smaller and more efficient servo-electronics will enable OEMs to increase the competitiveness of their products. Robots will become more agile with additional degrees of freedom and less mass to accelerate.

Barrett Technology Inc

Phase II Award No.: 1058474

Award Amount: $481,971.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Force-Controlled Robotic Arm Capable of Sub-Millimeter Precision

This Small Business Innovation Research (SBIR) Phase II project proposes a portable, interactive Coordinate Measuring Machine (CMM) for geometric data collection consistent with statistical sampling of a series of parts. The innovation exploits a characteristic of cable drives that supports precise repeatability in an articulated arm. To optimize production and avoid scrap generation, manufacturing process corrections must occur promptly and yet must be based on adequate measurement data. Existing metrology systems inhibit these preferred statistical process control principles. Large motorized CMMs are either taught offline using computer-aided design (CAD) models or online using awkward joystick interfaces. Manual-only portable-arm CMMs are safe and convenient to use, but teach-and-playback is not supported. The proposed solution is a motorized articulated robot that combines the safety of a manual system with playback precision thereby supporting convenient statistical process control (SPC). The research objectives are to design and build a motorized CMM and develop the algorithms, tools, and procedures needed to create a successful product.

The anticipated commercialized product will be a portable, user-friendly, cost-effective robotic arm that spreads the quality advantages of statistical process control across a broad range of products and manufacturers including non-traditional manufacturing such as medical surgery. The broader impact/commercial potential of this project has four parts. The first is the direct impact on the US economy. US workers will assemble, test, and ship the products developed under this SBIR. Components will be sourced from local US fabricators and OEM suppliers, boosting the US economy and generating taxes; and some of these products will become exports, reducing the US imbalance of trade. Secondly, the shortcomings of metrology devices available today discourage the use of statistical process control, thereby undermining manufacturing quality. The proposed solution will improve manufacturing competitiveness in the metrology market sector through easier adoption of statistical process control, leading to higher quality and reduced scrap costs. Thirdly, the proposed solution invites production-line workers back into close physical contact with the process that they must ultimately understand and control. The worker strengthens intuition by teaching the device for each new part geometry, while the playback capability avoids tedium and repetitive stress. Corporations often automate these workers out of their skilled jobs who then join the unemployed while the company loses touch with the ability to understand and innovate processes. Finally, this SBIR will support formal internship programs with several universities in order to maintain diversity.

Barrett Technology Inc

Phase II Award No.: 1152562

Award Amount: $465,156.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: A Resilient and Underactuated Robotic Hand Capable of Both Power and Precision Grasping

This Small Business Innovation Research Phase II project proposes a robotic hand based on a novel torque-switching mechanism and patented miniature motor controllers. The mechanism actively channels motor torque along different transmission paths and enables dependant and independent (time-discreet) control of both finger joints in a robotic hand to perform both power and pinch grasps. There is a growing need in industry for adaptable and flexible manufacturing capabilities in a dynamic environment. Industry generally uses single-axis grippers and end-effectors that are modified to pick up specific items in a highly-controlled environment. This requires exchanging multiple customized and expensive grippers via tool-changers. This project's goal is to produce a paradigm shift in the materials-handling industry by introducing a highly flexible, affordable, and lightweight robotic gripper that can grasp and manipulate objects of varying size, shape, and stiffness. The Phase-II project objectives are to design and develop a prototype 3-fingered gripper using a novel torque-switching mechanism, optimized motors, multiple feedback sensors, and miniature control electronics, and to test and evaluate the prototype gripper in an industrial setting. This program will result in a compact, lightweight, and affordable robotic hand capable of grasping and manipulating a large range of objects.

The broader impact/commercial potential of this project addresses the shortcomings of gripper devices available today which discourage the use of robotic systems, thereby undermining manufacturing productivity. The proposed solution improves manufacturing competitiveness by enabling easier adoption of robotic work cells in conventional markets such as light manufacturing and emerging markets such as the food and beverage industry. The societal impact will be felt in the field of education where robotics is recognized as a strategic motivator for children and young adults to enter into technical fields. Most robots are too large and dangerous to bring into a classroom. The proposed robotic hand will be very portable, safe, and exciting for both educators and students. A significant increase in gripper dexterity will make it an even more attractive motivator in the classroom and other secondary educational programs and workshops. A potential secondary application for this innovation is a more dexterous and lightweight hand prosthesis which could have a major societal impact. Finally, the ability to transmit torque through different paths in a miniature package and allow control of different functions with a single small actuator enables lightweight yet versatile machines and could have impacts beyond the field of robotics.

Berkeley Exotech, Inc.

Phase II Award No.: 0924037
Phase IIB Award No.: 1152460

Award Amount: $1,008,000.00

Start Date: August 1, 2009
End Date: July 31, 2013

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Sector: Electronic Systems and Instruments

STTR Phase II: In-Home Rehabilitation System for Post Stroke Patients

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II project proposes to create an in-home gait training device that allows a post-stroke patient to undergo rehabilitation with little or no assistance. Approximately 500,000 Americans survive a stroke each year. Miraculously, most stroke survivors can relearn skills, such as walking, that are lost when part of the brain is damaged. They can relearn walking most effectively if they are aided in making the correct motions by a machine or a physical therapist while attempting to walk. This training is expensive and requires the patient to make regular visits to a stroke center or qualified physical therapy center. Berkeley Bionics proposes to create a lightweight robotic exoskeleton which cradles a patient's lower extremities and torso, and maneuvers their rehabilitating limbs for them.

The broader impacts of this research are immense. These devices could move most post-stroke rehabilitation out of the clinical setting thereby reducing labor costs dramatically. The gait training exoskeletons will be wearable, very unobtrusive, and allow patients to maneuver in the real world. Patients would therefore be able to wear such devices for most of the day, thus remaining mobile and gaining the therapeutic effects of physical therapy over the course of a day, rather than just a short session. Furthermore, creating such a device will also give clinicians an alternative to the wheelchair to assist patients who are unable to recover adequate mobility to function in their daily lives. This could potentially reduce unhealthy effects of wheelchair use for millions.

Berkeley Exotech, Inc.

Phase II Award No.: 1026872

Award Amount: $500,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Integrated Powered Knee-Ankle Prosthetic System

This Small Business Technology Transfer (STTR) Phase II project proposes the development of an integrated powered knee-ankle prosthesis. The objective of this proposal is to investigate the use of integrated powered knee and ankle joints in trans-femoral prostheses that use sensory information from the ground and the wearer. The hypothesis is that a prosthesis with actively powered knee and ankle joints will significantly enhance the mobility of trans-femoral amputees while walking on level grounds, as well as stairs and slopes. The inability to deliver power to prosthetic systems has significantly impaired their ability to restore many locomotive functions. This proposal will derive a set of guidelines on design and control of an integrated powered knee and ankle prosthetic system which will improve locomotion function such as walking up stairs, walking up slopes, running, jumping, and as hypothesized in this proposal, even level walking. The proposed work will result in new theoretical frameworks for control and sensory systems, and the design of such systems. Major intellectual contributions will include the design of power systems; development of the sensory system to obtain information from the ground and from the user; the development of a control framework for the interactive control of prostheses; and the development of adaptive and robust controllers for impedance modulation during locomotion.

This project intends to create principles that provide significantly greater functional capabilities for above-knee amputees. Specifically, our work will enable more natural, stable, and adaptable prostheses. These research elements in this proposal will also form a foundation for powered orthotic systems. Additional significant benefits of this work include fostering a broader awareness and increased sensitivity of young engineers and educational institutions to disability issues. Limb loss is also afflicting a growing number of military personnel serving in recent conflicts, as well as a far larger number of veterans from previous wars. The recent Middle East conflicts have resulted in a number of young amputees, many of whom still shoulder the responsibility of raising families and anticipate a working life ahead of them. The integrated knee-ankle prosthetic proposed here will have a direct impact on the mobility of the trans-femoral amputees and their quality of life, and most likely alleviate the long-term consequences related to musculoskeletal health.

Blendics, Inc.

Phase II Award No.: 0924010
Phase IIB Award No.: 1237325

Award Amount: $599,414.00

Start Date: September 1, 2009
End Date: June 30, 2012

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Sector: Electronic Systems and Instruments

STTR Phase II: Blended Clocked and Clockless Integrated Circuit Systems

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Technology Transfer (STTR) Phase II research project will develop and apply a principled design methodology to confront the serious problems associated with deep sub-micron, system-on-chip, integrated-circuit designs. The project will develop design services for companies wishing to market complex, proprietary, low-power integrated circuits through the development of a unique design tool, one which will apply a mathematically sound approach to the production of large, hazard-free, network-on-chip products. The goal for this tool is to reduce traditional design cycles by eliminating most of the global verification effort while improving the robustness of the design. New results in predicting the behavior of deep submicron arbiter circuits are essential to this work and will also be reported.

The broader impacts of this research are to reduce design costs, time-to-market and power consumption. More broadly this can: 1) significantly increase the productivity of integrated-circuit design engineers, 2) reduce power consumption of electronic control, communication and computational systems and 3) increase our competitiveness against off-shore system-on-chip designers particularly with respect to low volume products. Thus, successful completion of this project is important to the future of the national electronics marketplace because, without a major reduction in the time spent on global verification, the benefits of higher levels of integration, including reductions in time-to-market, conservation of power and increases in reliability, will not be available to many important electronics market sectors.

Bluewater Technology

Phase II Award No.: 1058569

Award Amount: $444,880.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Commutational Ramp Load Disk Drive Actuator

This Small Business Innovation Research (SBIR) Phase II project will design, build, test, and validate a fully operational prototype disk drive incorporating a commutational ramp load actuator (CRLA). The CRLA is a unique and transformative actuator for disk drives that provides significant improvements over existing actuator technology by increasing performance and reducing cost. The research objectives consist of a systematic distributed parameter design for the CRLA components, quantification of intrinsic parameters and performance characteristics, design and synthesis of a robust trajectory and control algorithm to fulfill the ramp load/unload requirements, and verification of repeatability and reliability of the ramp load/unload process. The CRLA design requires travel through a magnetic transition zone which presents an input singularity at a location on the ramp within the actuator sweep angle resulting from a zero torque factor. To promote travel on the ramp and through the region near the input singularity point on the ramp, a robust closed-loop control algorithm will be developed that will provide failsafe ramp load/unload operation through the transition zone. It is anticipated that the research will lead to a technically sound and robust CRLA prototype actuator which will provide significant performance improvements and cost savings.

The broader impact/commercial potential of this project is immediate and long-term. The immediate commercial potential is the specific application of the technology to the current 550 million units per year disk drive market for computers, servers, data backup systems, communication technologies, and many consumer products such as digital video recorders. The CRLA technology is expected to provide cost savings of $0.17 to $0.47 on magnet, coil, and latch materials for each disk drive. Additional cost savings are realized through a reduction in product liability, warranty, and return costs. This technology will provide a direct benefit to society via manufacture of a consumer product that is of a lower cost and higher performance. This innovation will enhance scientific and technological understanding of devices that require 'control through singular regions,' with potential application in diesel engines and various military defense and security technologies. Additional broader impacts include: (a) realistic engineering training for students; (b) improving local economy by creating manufacturing jobs; (c) involvement of undergraduate students and preparation of project modules to enhance undergraduate curriculum; (d) collaboration with practicing engineers; and (e) immediate transfer of technology to disk drive industry.

Energid Technologies

Phase II Award No.: 0848925
Phase IIB Award No.: 1157516

Award Amount: $1,233,950.00

Start Date: March 1, 2009
End Date: August 31, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Real-Time Roboting Grasping System

This Small Business Innovation Research (SBIR) Phase II research project will create an information-based robotic grasping framework to enable practical grasping of objects for any robotic manipulator and any robotic hand, or even multiple hands. Grasp algorithms are stored in an XML database organized in a tree structure that allows rapid access and uses intelligent caching for very large databases. When a new object is presented to the grasping system, best matches are found in the database and the corresponding algorithms are extrapolated to determine the best grasp for the new object. Shape, surface properties, and articulation are used for matching. The techniques support the grasping of moving objects that can be tracked with a vision-based system. For constructing the grasp database, human supervisors train new grasps by simply picking up objects and giving special cues. Collection devices, such as data gloves and machine vision systems, are used to collect the supervisor's hand position and contact forces, and a learning module finds new grasps by coupling supervisory input with simulation-based optimization, using high-fidelity dynamic modeling. For optimization, control and configuration parameters (in end-effector space) are perturbed iteratively using nonlinear numerical optimization techniques.

If successful the creation of a comprehensive grasping framework as proposed in this project will have broad impact to research, industry, and society. Traditional grasping systems require specialized coding for new tasks and new robots. The proposed system will facilitate specific instantiations of general grasping algorithms. Application to virtually any robot manipulator, any hand, and any object to be grasped will be possible. This unprecedented flexibility, coupled with advanced and innovative grasping algorithms will play a role in advancing general purpose robots (those that can do multiple tasks without reprogramming). Robots with the ability to grasp hold promise for industries with labor shortages. The agricultural industry, for instance, will use robotic grasping for harvesting. Grasping robots will work in dangerous environments. An example application is rescuing injured humans in dangerous situations. Next-generation robots will assist the disabled with intelligent manipulators that can open doors and pick up objects. Grasping robots will support manufacturing and warehouse businesses. The simulation capability that is part of this research will allow new grasping strategies to be tested safely in a virtual environment before being implemented and fielded.

Fidelity Comtech Inc.

Phase II Award No.: 1058597

Award Amount: $496,450.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Dynamic Broadband Wireless Networks

This Small Business Innovation Research (SBIR) Phase II project will demonstrate the ability of an adaptive antenna system - a radio with an antenna that changes its radiation pattern to provide coverage where it is needed - to automatically optimize coverage. Harsh RF environments, for example those with shifting reflective surfaces such as shipping container yards, make it hard to set up reliable communication even when there is only one radio. When several radios must work together to provide coverage in an extended area, it is extremely difficult and time-consuming to manually tailor the radiation pattern of each antenna so that every portion of the area receives adequate signal and the radios do not interfere with each other. Through a combination of innovative pattern computation algorithms and active sensor feedback, the system resulting from this project will automatically tailor coverage to meet these goals. The system will not just be able to set up the initial coverage of an area, it will also continually monitor the quality of the coverage and automatically adjust to changes in the system or the environment that may affect the quality of that coverage.

The broader impact/commercial potential of this project is decreased deployment costs and substantially increased reliability. In the short run, the system will be built with a WiFi platform for use in the maritime ports market as a more reliable communication system to run their mission critical scheduling application. The deployment savings result from not only a quicker and more reliable initial setup but also from automated adjustments to coverage as environmental factors change including such radical changes as the failure of one radio. Because the system is agnostic to the frequency and the protocol used by the radio, it is not limited to WiFi deployments. The project will demonstrate this by creating and operating a prototype WiMAX version of the adaptive antenna system. In the long term, this adaptive antenna technology offers significant benefits to any large scale radio deployment. For example, as providers roll out the next generation of cellular, cell sizes will shrink significantly which will substantially increase the deployment cost. An adaptive antenna system offers not only the promise of reducing these costs but also adding increased connection reliability to these next generation systems.

HMicro, Inc.

Phase II Award No.: 0848913
Phase IIB Award No.: 1132037

Award Amount: $1,100,000.00

Start Date: March 15, 2009
End Date: August 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Wireless Healthcare Disposables

This Small Business Innovation Research (SBIR) Phase II research project will further validate a groundbreaking wireless semiconductor platform that enables disposable, body-worn, physiological monitoring wireless sensors (wireless disposables) for a wide range of applications in healthcare and other industries. The company's chips are combined with today's body sensors such as electrocardiogram (ECG), Saturation of Peripheral Oxygen (SpO2), and blood pressure, to produce wireless disposables for continuous monitoring. For mass deployment, wireless disposables must displace today's wired sensors, therefore must have equally low cost, similar reliability, and days of operating life for a single use. Conventional radios are too unreliable, too power hungry and cause high interference to meet this challenge. The company is creating a single chip solution by combining radio with sensor functions providing a gain of 50X over conventional radio based solutions in terms of low power, low cost and wire-like reliability.

Eliminating the wires connecting a person's body to a patient monitor long held as impossible to replace could be possible with the proposed solution. Healthcare markets, the initial focus of the company (dominated by hospital use), represent more than a $2B market in disposables. The wireless disposables will have a broad global impact by contributing to cost effective, high quality care in hospitals and other care settings. In hospitals, wireless disposables can eliminate reusable monitoring wires, products which have been demonstrated to carry drug resistant pathogens in up to 75% of cases. Wireless disposables are also aligned with a future vision of highly automated institutions that support a more natural workflow. Outside the hospital, wireless disposables allow remote and mobile monitoring of people with chronic diseases, enabling early interventions, an important goal in maintaining health and lowering costs. Wireless disposables will help solve the global healthcare crisis, with US costs over $1.5 trillion and rising rapidly as 78 million baby boomers near retirement.

KWJ Engineering Incorporated

Phase II Award No.: 1058563

Award Amount: $505,014.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Screen-Printed Gas Sensor Using Nanoparticulate Catalyst

This Small Business Innovation Research (SBIR) Phase II project seeks to combine the technology for a high performance amperometric gas sensor, AGS, with the fabrication methods of printed electronics, first for sensing carbon monoxide (CO). In Phase I KWJ demonstrated a unique combination of technologies and fabricated a CO sensor that, in performance testing, was compared to commercial sensors 10-100 times larger and 10-100 times more expensive. The new unique geometry sensor response characteristics we as good or better than commercial sensors. The printed-AGS sensor provides a general platform for sensors that is both low cost and high performance. In Phase II, this novel Printed-CO-sensor and the process for fabrication will be optimized and innovative beta-prototypes designed and fabricated. The prototype sensors will be subjected to comprehensive testing and integrated with state-of-the-art electronics including tiny micro-powered RFID technology to demonstrate a fully compensated, high performance, yet low-cost, CO sensor and sensor system. This would represent the first major advancement of AGS technology in the USA in several decades, and the resulting product is potentially disruptive to the marketplace.

The broader impact/commercial potential of this project lies in the ability of this novel, inexpensive printed gas sensor to combine the high performance found in the AGS technology and the modern fabrication technology from the microelectronics industry. The innovative products from this NSF SBIR can open a new landscape for sensor use. Legislative trends are pointing to a need for a low cost, high performance CO sensor. The result of this work will be the next leap forward in the existing widely used AGSs for monitoring. Initial impacts will include: 1] improvements in CO sensors allowing high performance home CO alarms to better protect human health as well as property, 2] widespread monitoring capability in transportation and infrastructure applications, important to both safety and homeland security; and 3] the ability to integrate gas monitoring into consumer products and create instant worldwide networks to monitor and assess for improved health and safety as well as environmental protection. The printed AGS may not only replace millions of larger sensors now sold, reducing cost and material use by 10-100X, providing a greener footprint for sensors, but also enable evolution of high performance sensing capability into new and larger markets.

Mound Laser & Photonics Center, Inc.

Phase II Award No.: 1058443

Award Amount: $499,734.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: IDT Sensors for Monitoring Wind Energy Infrastructure

This Small Business Innovation Research (SBIR) Phase II project will demonstrate an inspection and monitoring sensor system that addresses the problem of structural evaluation of composite components with an innovative nondestructive evaluation (NDE) sensor system. Composites have always been a challenge for inspection due to their multilayer and anisotropic material construction. This challenge is increased when dealing with wind turbine blades due to their enormous size, construction, strength requirements, operational environment, and safety considerations. The Phase II effort will further upgrade and refine the sensor operational capabilities developed in Phase I. The signal to noise ratio and inspection coverage area (sensor footprint) will be further improved. The system capability will be expanded so that a single control unit can operate and receive data from a networked array of sensor. The sensor system will have application during manufacture to verify part quality, for pre- and post-installation inspection to check for shipping or assembly damage and during the component's service life as a structural health monitor system. These sensors offer the possibility for substantial savings and reduction of downtime as manufacturing defects are discovered at the point of origin, before catastrophic blade failure can occur.

The broader impact/commercial potential of this project will be to facilitate the economical installation and operation of wind energy generators. The U.S. has set a goal of 20% (300GW) of electrical power to be generated from wind by 2030. Based on the typical utility scale turbine (1.5-2.0MW) this translates to having over 500,000 turbine blades in domestic service by 2030. Depending on the wind turbine size, blade costs are $55k to $300k each with a 1.5-2.0MW turbine costing $2-3M to install. The growth of wind energy represents a huge manufacturing challenge to produce, install and maintain the turbine blades. The sensor system developed during this program has the potential to detect defects or damage both early in the supply chain and during the life cycle so that expensive energy capacity downtime or catastrophic tower failures can be avoid. Blade failure is not only a cost issue but also a safety one as well. An accurate method for inspection of complex blade structures can have a major economic impact on the industry. The sensor system being developed also has use in Aerospace and Infrastructure/Bridge applications.

Perpetua Power Source Technologies, Inc.

Phase II Award No.: 1058551

Award Amount: $499,984.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Flexible Thin-Film Thermoelectric Wearable Energy Harvester

This Small Business Innovation Research (SBIR) Phase II project addresses the need for renewably powered and always available energy for powering personal medical and other location aware sensors. The project advances wearable thermoelectric generator (WTEG) technology. The system will yield new advances in terms of miniaturization, increases in WTEG power densities, application of advanced heat transfer materials, and integration with cutting edge locator system electronics. The research focuses on matching the thermal resistance of the thermoelectric generator with the thermal resistance of the skin to air interface, accomplished through the optimization of thermocouple geometries implemented in thin film semiconductors applied to a flexible polyimide substrate. The anticipated result of the research will be a fully functional wristband locator system that is lightweight, adjustable, waterproof, and renewably powered from the human body.

The broader impact/commercial potential of this project includes applications for location tracking of Alzheimer's patients, nursing home patients, and elderly home healthcare. As our population ages, achieving a balance between personal independence while providing for primary healthcare monitoring will be critical. Wearable thermoelectric generator technology can be used to power wireless sensors that monitor patient location and help facilities track 'at risk' residents. Additionally, wireless sensors can help healthcare providers improve treatment, increase efficiency, and cut costs. A wide range of other follow-on medical applications include glucose monitoring for diabetic treatment and care, diagnosing sleep disorders, and the physiological monitoring of first responders, law enforcement, and soldiers. Each of these applications has been limited by finite and limited battery life. Harvesting body heat and converting to usable electrical energy opens up a new era of autonomous wearable devices.

Potomac Photonics Inc

Phase II Award No.: 1058133

Award Amount: $544,801.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Energy Storage, Electrical Distribution, and Packaging for Wireless Sensor Networks

This Small Business Innovation Research Phase II Project targets development of a new approach to building wireless sensor infrastructure energy storage systems, electrical distribution, and packaging - that allows dramatic miniaturization of wireless sensor nodes, eliminates most restrictions on their shape and is environmentally-friendly. Accomplishing these goals requires development of innovative new approaches to fabrication of mesoscale electronic circuitry and thin film energy storage batteries. Laser-based approaches to making very fine feature conductor patterns, vias, and mechanical structures in a variety of organic and inorganic materials commonly used in the electronics industry will be utilized. New battery chemistry will also be refined to allow fabrication of miniature, flexible, thin film batteries with energy storage densities substantially exceeding those of any battery currently on the market. Together these innovations will allow nearly an order of magnitude reduction in volume of wireless sensing devices.

Combination of the laser processing and battery technologies developed in this project will offer an approach to miniaturization of almost any wireless sensor that is easily adaptable to most sensor designs. The broader impact/commercial potential of this project will be found in many areas of everyday life. After an extended incubation period, wireless sensing networks are experiencing a surge of market growth. A market opportunity for more than 100 million sensor nodes is projected for 2019. Potential applications come from areas as diverse as infrastructure monitoring for bridges, roadways and pipelines, lighting and HVAC control in buildings, electrical metering, parking management, patient monitoring, elderly care, seismic sensors, industrial process control, crop water management, and home automation. In the health care area alone, wireless sensor networks could potentially produce and estimated $25 billion savings world wide. Feasibility of many potential applications will be strongly influenced by the availability of miniaturized sensor nodes with suitable form factors that can be operated without maintenance for extended periods. Targeting miniaturization and power sources, the proposed project addresses and solves key historical bottlenecks in sensor network implementation. It will have a significant impact on these large developing markets, as well as spin-off applications in medical and consumer electronics.

Privatran

Phase II Award No.: 1127537

Award Amount: $390,810.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Massively Dense 3D Integrated Memory

This Small Business Innovation Research (SBIR) Phase II project will further develop a two-terminal, electronically-programmable, nonvolatile memory array using materials commonly found in integrated circuit (IC) manufacturing. Each element is smaller than a single transistor and is formed using standard IC layers. This results in a three-dimensional (3D) integrated memory (3DIM) architecture achieved using a single substrate without need to assemble multiple die or wafers together with advanced bonding techniques. The ON/OFF conductance ratio and switching speed of these devices exceed the performance of competing technologies. Current flows through nanometer-sized regions of the device, and, as a result, the memory elements will scale to smaller dimensions without reducing the current through the device, thereby resulting in a dense memory array architecture with improved signal-to-noise ratio for each subsequent IC technology. The proposed overall program will include integrating a passivation layer, connecting each element with an isolation diode, optimizing device architecture to minimize footprint, and implementing 3DIM control and drive interface electronics. The program proposed herein addresses the topic by providing material innovations for improved performance in electronics where nano-scale semiconducting filaments are fabricated within a dielectric material for commercial data storage applications.

The broader impact/commercial potential of this project are in the areas of microelectronics chip manufacturing for wireless, mobile internet and other portable devices using nonvolatile memory. Memristive device arrays impact numerous commercial markets including flash and embedded memory, and offer orders of magnitude more density as compared to conventional memory. By implementing massively dense 3D memory array architecture on a single substrate, there is no need to fabricate multiple substrates and bond them together, thereby simplifying the fabrication process, reducing manufacturing cost and increasing yield. In addition to portable devices, the proposed device may find applications in space-based earth sciences and astronomy since it is tolerant to x-ray and heavy ion radiation. Some recent approaches to achieve 3D memory on a single substrate have not been successful due to problems with external fields causing bit errors and low signal-to-noise ratio, or because device operation is based on thermal, ionic transport, or phase-change mechanisms that are inherently slow. The proposed memory elements are controlled using electrical signals rather than thermal or chemical energy, making them highly efficient and faster than competing technologies. Memory arrays will be fabricated in a commercial foundry and scaled to smaller dimensions throughout the Phase II project.

QuantTera

Phase II Award No.: 1127568

Award Amount: $465,497.00

Start Date: November 15, 2011
End Date: October 31, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Ultra Low Power InAsN Semiconductor Transistors

This Small Business Innovation Research (SBIR) Phase II project will demonstrate a new III-V nitride semiconductor alloy and bipolar transistor structure with the potential to enable ultra low power device operation in applications requiring both Radio Frequency (RF) and digital electronics. The problem to be solved is that for RF power amplifier increasing power efficiency has been a major issue for portable and high performance electronic devices. The research objectives is to demonstrate on a standard gallium arsenide (GaAs) transistor platform that the inclusion of our low band gap nitride semiconductor will significantly reduce the turn on voltage, thus increasing the battery life of the device. Our research will start from the development of a low bandgap material to the fabrication of transistor that will be compared to the specifications of cellular based RF amplifiers. This program will begin with device design and material synthesis and end with prototype demonstrations, with our commercial partners.

The broader impact/commercial potential of this project will have a huge impact on power consumption in the realm of high-performance personal communication electronics, as the requirement for greater functionality in cell phones rises. GaAs wafers dominate the market for amplifiers in wireless communication products. Transistors have advantages over existing standard GaAs-based devices with reduced power consumption could impact the entire electronics industry. As portable or wireless cellular devices continue to become ever more functional they will require significantly lower turn-on voltages so as to minimize power consumption while sustaining operation over longer periods of time. The overall structure of the project has been designed to provide enriching opportunities in the areas of teaching and training for both the graduate students and university researchers. The exchange ideas between industry and academia will ensure research candidates with an excellent technical background and a sophisticated understanding of the industrial environment.

Rehabtek LLC

Phase II Award No.: 1058612

Award Amount: $527,991.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Developing a Pivoting-sliding Elliptical Machine for Knee Injury Prevention/Rehabilitation

This Small Business Innovation Research (SBIR) Phase II project develops a new exercise device for neuromuscular training about the minor/secondary axes to reduce and prevent lower-limb injuries. Considering joints in the lower-limb including knee and ankle are free to flex-extend but with much more limited motions about the minor/secondary axes (leg twisting and side sway at the knee and ankle twisting and side sway), injuries often occur with excessive minor/secondary axis loadings. However, there is a lack of convenient and effective devices that can be used to train minor/secondary-axis neuromuscular control of human lower-limb during functional major-axis stepping/running movements. This project will address the strong exercise and clinical needs and develop a unique minor/secondary-axis exercising device to help subjects improve minor/secondary-axis neuromuscular control and rehabilitate/prevent knee/ankle injuries associated with excessive minor/secondary-axes loadings. Practically, this minor/secondary-axis exercising mechanism can be implemented with many existing exercise machines (elliptical machine, stepper, stair climber, bicycles, and leg press machines) for minor/secondary-axis training. As a powerful clinical evaluation tool, this system can also provide quantitative outcome evaluation.

The broader impact/commercial potential of this project includes the novel training modality, widely used exercise platforms, and focused training protocol. The proposed unique minor/secondary-axis neuromuscular training device may directly help reduce various lower limb injuries. Furthermore, it may benefit multiple joints in the human lower (and potentially upper in a similar way) limbs and it may benefit individuals with minor/secondary-axis impairments in neurological disorders as well as musculoskeletal injuries. Similarly, the widely occurring knee osteoarthritis and leading cause of disability is closely associated with unbalanced/improper frontal plane loadings. The proposed minor/secondary-axis training device will provide a general platform and training strategy to help people better deal with potentially injurious off-axis loadings of the whole lower limbs with quantitative outcome evaluations. Practically, the minor/secondary-axis training can be implemented on various common exercise equipment including elliptical machines, steppers, stair climbers, and bicycles. The minor/secondary-axis training device can be used in hospitals/clinics for post-surgery/injury rehabilitation, and in gym and home settings for injury prevention training as well as rehabilitation. People of various ages and at various sports/activity levels can be trained to better prepare for potentially injurious off-axis loadings and avoid potential injuries.

Resensys, LLC

Phase II Award No.: 1026903

Award Amount: $499,033.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: An RF Radiation Empowered Sensing Method for Low Cost Structural State Monitoring

This Small Business Innovation Research Phase II project addresses the deteriorating situation with respect to our nation's infrastructure system, particularly bridges. A solution is critically needed to monitor the structural integrity of such systems in order to identify potential failures - such as the Minneapolis I-35W Bridge collapse - before they occur. Existing solutions for structural state sensing are expensive, labor intensive, non-scalable, and unreliable. Phase I demonstrated the feasibility of an innovative, cost-effective, non-intrusive, and scalable structural monitoring technology known as Active RF Test (ART). The investigators developed a prototype of a thin, mechanically flexible, patch-like wireless sensor that can be easily attached to distributed points of a structure. ART sensors are batteryless, with their energy supplied through an in-network RF energy radiation mechanism. Based on the Phase I success, Phase II will (1) optimize the architecture and enhance the capabilities of the ART sensors; (2) develop cost effective processes for high-volume production of the sensors; (3) develop analytical tools that generate a map of installation locations for ART sensors on a structure; (4) develop detection/diagnostics models based on the sensors; and (5) conduct a field evaluation of the ART system on two highway bridges.

The broader impact/commercial potential of this project is protecting the US infrastructure against aging, structural malfunction, and failures. Aging infrastructure poses a significant societal challenge: recent reports indicate that the US transportation infrastructure has 601,027 bridges, of which 71,419 are structurally deficient. Unique features of the proposed ART technology - such as easy installation, low cost, scalability, energy self sufficiency, and durability - make it an ideal response to this challenge. The attachment of ART patch sensors will be non-intrusive to a structure, the installation effort will be minimal, and no drilling will be required. The mechanical flexibility of the ART patch sensors will allow adaption to complex geometries, including bearing plates, gusset plates, joints, support cables, and truss systems on a bridge. Finally, ART technology features a multipurpose solution that can be tailored to structural integrity monitoring needs of different types of structures, including bridges, pipelines, dams, airframes, and offshore platforms. The 71, 419 structurally deficient US bridges alone represent a commercial market of $2.8 billion. The potential to address other structures, along with the potential for international sales, would enhance the opportunity.

Safaba Translation Solutions, LLC

Phase II Award No.: 1150589

Award Amount: $500,000.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Software-as-a-Service Customized Machine Translation for Commercial Language Service Providers and Their Clients

This Small Business Innovation Research Phase-II project develops advanced technology capabilities for constructing and deploying client-adapted automated language translation systems within commercial settings that are used by globalizing enterprises and the language service provider companies (LSPs) that provide translation services to such enterprise clients. The developed technology leverages databases of previously-translated material in order to produce client-adapted high-quality fully-automatic translations for commercial language service providers (LSPs) and their enterprise clients. This approach provides a scalable and less-costly solution for creating and deploying client-specific customized Machine Translation (MT) engines. Once deployed, these customized MT systems expand the capabilities of clients to translate volumes of content that are not feasible to translate using current methods.

The broader impact/commercial potential of this project lies in the impact that it will have on the broad commercial translation industry. The technology developed in the project is likely to significantly reduce barriers to wide-spread adoption of MT technology by the broad LSP industry and their enterprise client-base. The 2010 commercial translation market is a $26 billion industry, growing at a healthy pace. Current commercial MT offerings are expensive and too difficult to deploy for most enterprises and service providers. Free web-based translation services serve casual users, but do not meet the quality and security needs of enterprises. The technology developed in this project and the cloud-based delivery model support scalable, easy-to-integrate MT services, which are highly attractive to a broad range of potential clients. This approach will support cost-effective content generation into multiple target languages at a massive scale, a capability that is essential for globalizing US enterprises in order to compete in the information-rich market place of the 21st century.

Sensys Networks, Inc.

Phase II Award No.: 1057566

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Wireless Weigh-in-Motion

This Small Business Innovation Research (SBIR) Phase II project will develop a fully functional prototype of an accelerometer-based wireless Weigh In Motion (WIM) station. The WIM system will comprise an array of battery-powered 3' cubes, embedded in the pavement, each consisting of an accelerometer, a microprocessor for local signal processing, and a radio that sends the processed measurements to an Access Point (AP) on the side of the road. The AP estimates the pavement load from each axle of a truck at freeway speeds and the truck's class, and transmits these estimates to the traffic management center. The cubes take up minimal space and are installed within minutes, so WIM systems can be deployed anywhere at a fraction of the cost of traditional WIM stations. Phase I research demonstrated the technical feasibility and commercial potential of the WIM. The technical objectives of Phase II concern the WIM packaging and installation; calibration: sensitivity to weight, speed and temperature (especially for asphalt pavements); signal compression and source coding; channel coding; wide area data backhaul; overall system design; manufacturing prototype samples; and extensive testing.

The broader impact/commercial potential of this project is to dramatically enhance the regulation of truck weights and provide data to greatly improve the maintenance of the US road and bridge infrastructure by drastically reducing the costs of WIM stations. Current WIM stations have limited deployment as they are costly to install requiring shutting the road for days and needing expensive maintenance and re-calibration. The new WIM stations could be widely deployed in additional locations on arterial streets and near ports to monitor truck traffic and be a component in a truck weight-based enforcement and toll system. These WIM stations could also meet similar objectives in overseas markets creating employment for US residents with diverse skills in the design, manufacturing, sales, and installation.

SFC Fluidics, LLC

Phase II Award No.: 0848253
Phase IIB Award No.: 1157547

Award Amount: $891,010.00

Start Date: March 1, 2009
End Date: September 30, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Shape Variations in the Development of Miniature Micropumps

This Small Business Innovation Research (SBIR) Phase II research project focuses on the development of a product line of miniature pumping systems for the controlled delivery of fluids in ultra-low flow rate range (nanoliters to microliters per minute). This line of micropump systems will provide pulse-free flow and controlled micro-volume dispensing in this challenging low volume regime. The non-mechanical nature and operating principles of this pump afford an unusual degree of freedom in pump design. The ability to tailor the shape and size of the micropump to specific applications can be very valuable, particularly in small devices where the available space is significantly constrained (for example, point-of-care devices, portable chemical and biological analysis systems, and micro-dosing devices).

There is a growing diversity of chemical and biological analyses that are taking place within small chips, as well as in the rising demand for ultra-small dosing systems. Such analyses are continuing to shrink in size and measurements that have conventionally been performed in a laboratory and are now being adapted to handheld devices. These micro-analysis systems can provide immediate results without waiting for laboratory analyses. For example, the analysis of blood samples is being adapted to small devices, so important results are available at the point-of-care. Likewise, the desire is growing for small, portable dosing systems for animal studies and for human medications (like insulin and chronic pain management). All of these applications require micropumps for the controlled delivery of compounds. Fundamental engineering constraints mean that conventional mechanical pumps cannot be simply decreased in size to meet this challenge. These miniature non-mechanical pumps require very little power, can be controlled to deliver at constant flow rate or specific dispensing volumes, and offer the pulse-less flow that is not accessible by other pumps. This provides a significant market opportunity in the liquid pumping market (roughly $160 million presently), into the animal dosing (valued at approximately $90 million per year) and human drug delivery (valued at $80 billion presently) markets.

SpringActive, Inc.

Phase II Award No.: 0956828
Phase IIB Award No.: 1229943

Award Amount: $500,000.00

Start Date: February 1, 2010
End Date: June 30, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Compliant Jack Spring Actuators for Lower Limb Mobility

This Small Business Innovation Research (SBIR) Phase II project will develop a novel, spring-based, adjustable stiffness actuator, that will power future wearable robots and exoskeletons. The actuator will be integrated into a powered prosthetic ankle which will meet the demanding requirements for lower limb mobility. Its unique ability to tune stiffness allows it to be customized to an individual, a significant impact in the wearable robotics field. It will meet the demanding design requirements that include the tradeoffs between high power need, low energy usage, compliance, robust sensing of forces, and high cycle demands. The end result is a powered ankle-foot prosthesis that will provide near able-bodied function to a lower leg amputee.

The broader impact/commercial potential of this project is that it will restore normal walking function to below-the-knee amputees. Such a device will increase symmetry and duration of walking. In fact, a below-the-knee amputee wearing a passive prosthetic device typically uses 20-30% more energy to walk than an able bodied walker. Asymmetry in an amputees gait leads to joint pain, arthritis, and back pain. Because of the difficulty to walk, their conditions often lead to a more sedentary lifestyle decreasing their already limited mobility. It is documented that decreased mobility increases health risks. Elderly or overweight individuals may benefit from the technology as well. Adaptation of the technology to the powered orthosis market will expand its benefits to weak and disabled populations. In general, these groups have a more sedentary lifestyle and sometimes rely on the use of powered scooters. Because of the growing population of people with diabetes, elderly, and individuals with reduced walking ability, powered lower-limb robots will have a significant societal impact improving health by supporting an active lifestyle.

Square One Systems Design, Inc.

Phase II Award No.: 0923850
Phase IIB Award No.: 1151416

Award Amount: $762,626.00

Start Date: August 15, 2009
End Date: September 30, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Combining Mobility and Manipulation in a Tri-Sphere Robot

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II research project seeks to develop a radically new type of mobile robot. Most of today's robots rely on wheels to move from one location to another but the proposed Tri-Sphere robot moves by walking. This form of locomotion provides distinct advantages when the robot is called upon to negotiate cluttered terrain. The Tri-Sphere robot interacts with its environment via a unique six degree-of-freedom parallel manipulator. This manipulator allows the robot to dig, grasp and carry objects with exceptional dexterity. An important feature of the robot's design is that both its manipulator and its legs are driven by the same suite of six electric motors. This intrinsic mechanical simplicity results in an extremely robust mechanism well suited for dirty, difficult jobs.

The broader impact of this research is the creation of a new class of robots designed to combat the threat posed by land mines and other explosive devices. It is estimated that more than 60 million mines are in place throughout the world. The Tri-Sphere robot will provide a safe, reliable means of locating, unearthing and disposing of this unexplored ordnance. In addition, the Tri-Sphere design can be scaled to create versions of the robot tailored to the demands of mining, underwater trenching and other complex material handling operations that must be conducted in hazardous environments.

TagArray Incorporated

Phase II Award No.: 0822542
Phase IIB Award No.: 1049020

Award Amount: $1,000,000.00

Start Date: July 1, 2008
End Date: December 31, 2012

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Sector: Electronic Systems and Instruments

SBIR Phase II: Clock-on-Demand: High Performance, Ultra Low Power

This Small Business Innovation Research Phase II research project is to develop a prototype and proof of concept for the tag and reader that uses an innovative low power Clock-on-Demand (CoD) and baseband/media access controller (MAC) calibration algorithm to be used with ultra wideband communication systems. The new CoD and algorithm are motivated by application of ultra wideband to the RFID (Radio Frequency Identification) market. In this prototype, the CoD and the baseband/MAC layer algorithm are implemented in standard CMOS for tag and the UWB receiver and narrowband receiver with discrete components for reader. The low power requirement is achieved by the CoD and by dividing the time into epochs and epochs into slots. The CoD only runs until the tag transmits its impulse in the relevant slot, and the reader decodes the ID representations of all tags by the slot number. Therefore, if an epoch is divided into 210 slots, an impulse by tag represents 10 bits of the information. The robustness is achieved by having an UWB impulse transmitter in the tag and by repeating the impulse in different epochs.

RFID is an exponentially growing market. However, the technology that supports its expansion is not able to provide robust communication and signaling between a tag and a reader. Furthermore, today's technology only supports a low tag density (10s of tags/sec), while the applications that will fuel the exponential expansion of the RFID market, like point-of-sale, inventory management, shelf management, etc., require 100s and 1000s of tags/sec.

TestWorks

Phase II Award No.: 1152453

Award Amount: $500,000.00

Start Date: May 1, 2012
End Date: April 30, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Integrated Circuit Yield and Quality Improvement thru Test Data Analysis

This Small Business Innovation Research (SBIR) Phase II project develops an automated, software-based analysis methodology that enables yield and quality improvement of integrated circuits (ICs) through information extraction from test measurement data. Deriving actionable information from test data is a challenging task due to lack of software that automatically correlates test measurement data obtained from failing ICs and their physical IC-design description (i.e., the layout). Maximizing knowledge extraction is accomplished by a new software-based diagnosis technique that uses in conjunction the logical and layout descriptions, in addition to the measured test data, to identify at the nanometer scale, the precise location and type of defects within non-working ICs. The project also develops software-based statistical methods that find commonalities among the defects characterized within failing ICs. The combination of improved diagnosis and commonality analyses means that the root-causes for failure can be quickly found and passed on to designers, process engineers, and test engineers to guide remedy selection and deployment.

The broader impact/commercial potential of this project centers on continuing the advancement of the US semiconductor industry which is vital to both Homeland Security and the general advancement of society as a whole. There is significant commercial opportunity in supplying test data analysis on a per-design basis to Integrated Circuit (IC) producers that enables rapid improvement in yield and quality through feedback from manufacturing testing. The potential impact is tremendous since specific, pertinent information is fed back to both designers and manufacturers about how and why ICs fail. Chip designers will use this information to improve design rules for producing high-yielding and ultra-reliable ICs. Chip manufacturers will use this information to fine-tune their fabrication processes to maximize yield and performance, and optimize their test methodologies to ensure quality meets customer demands. It is also anticipated that this technology will also spur further research and broaden the scope of research in universities.

XW, LLC

Phase II Award No.: 1058599

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Electronic Systems and Instruments

SBIR Phase II: Ubiquitous Landline-Based Long-Reach Broadband Access

This Small Business Innovation Research (SBIR) Phase II project targets significantly increased throughputs and distances for broadband access over the existing copper landline infrastructure at low cost. In particular, the technology being developed offers advantages in interference-dominated and in suburban/rural environments. In the USA alone there are many millions of households that are currently out-of-reach of broadband access, where there are typically multiple copper landlines available, and the global demand for such solution is significantly higher. For these underserved subscribers, this innovative extended-reach solution represents the only low-cost broadband access alternative to costly, inefficient satellite coverage. While existing Digital-Subscriber-Line (DSL) solutions are not specified to provide broadband access at very long distances, the company's novel solution greatly increases the achievable distances and allows broadband rates (1Mbps) to be delivered at extended ranges, as demonstrated in Phase 1 of this project. The technology combines innovative signal-processing algorithms with novel digital implementation architectures to allow for high-performance reduced-complexity and low current-consumption implementations.

The broader impact and commercial potential of this project are in enabling affordable broadband service to the many households, which are currently out of the reach of broadband access, and in enhancing the performance of other copper-based applications. The technology will enable telco providers to better compete in areas where cable service exists, and can enhance existing solutions for copper-based backhaul, thereby helping service providers with the growing problem of backhaul bottlenecks associated with increased wireless traffic. The growing demand for solutions of this type has the potential to generate annual revenues on the order of $50M, representing a great business opportunity. Societal benefits include providing broadband service to previously-unreachable homes, thus allowing them to engage in remote education, e-commerce, and telecommuting, with all of the advantages that these entail. Ongoing collaborative research with local universities is serving to steer academic research in this field towards the actual needs and interests expressed by service providers, thus advancing the related fields in communication theory and circuitry design and involving students in this research.

XW, LLC

Phase II Award No.: 1152622

Award Amount: $500,000.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Electronic Systems and Instruments

SBIR Phase II: Crosstalk Mitigation for Copper-Based Cellular and Access Backhaul

This Small Business Innovation Research Phase 2 project targets the realization of a cost-effective solution for achieving increased data throughputs in the crosstalk-constrained copper-medium-based cellular and access backhaul networks, to address the growing demand for capacity experienced in them. Existing equipment, confined to the use of twisted-pairs due to the unavailability of fiber in most locations, often avoids the use of spectrally efficient VDSL, whose high-capacity comes at a cost of vulnerability to interference. The technology developed in Phase 1 of this project, and its implementation in hardware and software as part of the Phase 2 project, will effectively address this vulnerability of VDSL and recover most of its potential capacity through crosstalk cancellation. The company's key innovation is in non-iterative, low-latency, reduced-complexity, dynamic interference cancellation algorithms, which greatly enhance performance while requiring less than 10% of silicon-area increase in existing VDSL2 multi-channel solutions. The project will involve both research and development aspects, as well as system implementation challenges associated with the minimization of complexity and power consumption. Based on the Phase 1 project's successful validation of the technology's critically needed throughput enhancements and its commercial potential, it is anticipated that this technology will be widely incorporated in copper-based equipment.

The broader impact/commercial potential of this project is in extending the useful life of the existing in-ground copper infrastructure, thus allowing equipment providers to continue to focus their resources on delivering ever-increasing bandwidths, while also offsetting the high expense of new fiber deployment.

Benefits are also realized through the company's partnerships with universities, where the company works closely with key faculty and with students, provides seminars, and has an ongoing internship program that results in the full-time hiring of graduates. According to publicly available reports, mobile data traffic in North America is expected to increase by a factor of over 20 by the year 2015. This massive increase in data consumption, brought on primarily by the rapid adoption of smart-phones and bandwidth-intensive applications, is already placing an enormous burden on the backhaul infrastructure, which carries telecommunications for cellular, internet and landline voice traffic. Resolution of the bandwidth congestion requires significant improvement in telecom infrastructure including backhaul and access, both of which are largely copper-based in North America. The company's interference-mitigation technology will address this problem in a cost-effective manner by allowing the growing demand for bandwidth to be satisfied with the existing infrastructure.

2Cimple Inc

Phase II Award No.: 1026539

Award Amount: $499,980.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Interactive video based Contextual & Dynamic Application Access

This Small Business Innovation Research (SBIR) Phase II project will address a significant problem for Video Publishers: How to enhance the monetization of online video content. Online video is more than doubling in consumption year over year (31 billion views in November 2009). However, it is believed that the video publishers are not able to fully capitalize on this massive online video trend because they are using a single source revenue model via Pre-, Mid- and Post-Roll advertising that has limited revenue opportunity, declining prices, and negative viewer experiences. 2Cimple is developing a solution, an Interactive Video Applications Platform that has the potential to increase a publisher's online video revenue. This platform, dynamically associates and pushes relevant interactive video applications to consumers while providing a "user-controlled" opt-in environment that results in a higher degree of viewer experience and engagement. The platform is built on flexible and scalable client-server architecture based on industry-standard technology components. The technology uniqueness includes a dynamically configurable Video Player, an application server capable of automatic video context detection and dynamic application insertion, an open application development platform, integrated video and application analytics, customized reports, and a simplified management system.

If successful, the platform has commercialization potential that introduces efficiency into the online video value chain by increasing revenue for publishers, optimizing budgets for sponsors, and providing a higher degree of engagement and enhanced viewing experience for consumers. This platform will enable a new web-based eco-system built around online video that will spur advancements and innovation in video and software technologies and provide economical benefits to all participants. The platform provides a brand new engagement model enabling "user-controlled" contextually relevant, dynamically-inserted, call-to-action applications and other rich media experiences.

422 Group

Phase II Award No.: 0956891
Phase IIB Award No.: 1234072

Award Amount: $500,000.00

Start Date: February 15, 2010
End Date: April 30, 2012

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Sector: IT Applications

SBIR Phase II: An Innovative and More Effective Means to Manage the Communication Process Between Colleges and Prospective Students

This Small Business Innovation Research (SBIR) Phase II project proposes to commercialize a predictive modeling technology that automatically adapts to changing interaction patterns between providers of higher education (colleges and universities) and consumers (prospective students). Current methods produce only retrospective static models which, due to peculiarities of the higher education recruitment cycle, require at least a one-year lag between data acquisition and application to new prospects. As a result, data mining techniques have gained only limited popularity in college recruiting. The approach proposed here employs a proprietary adaptive modeling engine (AME) to leverage real-time transactional data from a CRM system and dynamically update scoring algorithms to predict outcomes. AME relies on a logical interface and unified dimensional data model to extract analyzable record-sets accurately representing the state of underlying transactional data at any time-slice within the system's effective-dated range. The integration of these key technologies allow relationship patterns to be identified in the recruitment process as they occur and scoring algorithms to dynamically adapt to changing patterns within a single recruitment cycle.

It is believed that the changing demographics of college-going students will present a number of significant obstacles to the traditional college business model and could jeopardize the future financial health of many higher education providers in this county. The decade-long trend of yearly increases in demand, as represented by the number of new students entering college, comes to an end in 2009. In stark contrast to the 24% growth the market has experienced over the past decade, future enrollment numbers will remain stagnant overall, and in many localities college enrollment will actually decline. Furthermore, dramatic shifts are coming in the geodemographic, ethnic, and cultural mix of high school graduates that feed the higher education market. As competition for students increases dramatically in the face of rising attendance costs, dwindling endowments, changing demographics, and a decline in college-bound students, each college's ability to survive, much less prosper, will depend directly on its ability to identify, understand, and communicate with students in a more efficient and cost-effective manner. Those that are able to adapt this new landscape through the use of innovative tools like AME will flourish, and those who are unable to adapt will face an uncertain future of declining enrollments and financial instability.

app2you

Phase II Award No.: 0956905

Award Amount: $499,955.00

Start Date: April 15, 2010
End Date: June 30, 2012

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Sector: IT Applications

SBIR Phase II: Do-It-Yourself database-driven web applications from high level specifications

This Small Business Innovation Research (SBIR) Phase II proposal discusses the continued commercialization and research & development plans of App2You, Inc., developer of a Web-based platform that enables non-programmers to rapidly create and evolve fully custom hosted forms-driven workflow applications where users with different roles and rights interact. Such a platform will have a broad impact on organizations of all sizes by empowering nonprogrammer business process owners to quickly and easily deploy applications that capture the business processes of their organizations. Preliminary results from Phase I engagements shows that the platform has the maximum impact on enabling externally-facing Customer Relationship Management (CRM) for Small and Medium Businesses (SMBs), which use the applications to facilitate and streamline interactions with customers and partners, achieve lower process management and customer/ partner servicing costs, increase customer/partner satisfaction and grow revenues.

App2You has the potential to operate as an equalizer between large companies and SMBs with limited time and money available to for their IT infrastructure, since it enables the latter to obtain applications for their processes despite limited resources. Phase II will expand the impact by systematically reaching SMBs and promoting the use of the platform, making its use even simpler, and also finding additional verticals, such as forms distributorships and form abandonment cases, where forms-driven workflows can generate values. Finally the Phase II project will create enhancements that facilitate successful collaborations between business process owners and ad hoc information technology staff. If successful, the App2You platform has the potential to address an emerging and potentially significant opportunity in the SMB space.

Bioproduction Group, Inc.

Phase II Award No.: 1052566

Award Amount: $516,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: Enterprise Decision Making Using Activity Interaction Technology

This Small Business Innovation Research (SBIR) Phase II project seeks to further research and implement a Network Algorithm for efficiently running large-scale network simulations and using those simulations to perform enterprise planning and risk analysis. The company's algorithms (and associated early-release software) have been shown to run supply chain models one order of magnitude faster, with one order of magnitude more complexity, than current simulation models commonly deployed. Bioproduction Group has created a simulation methodology that meaningfully links together highly-detailed operational level models with its large network-scale model. Each operations simulation is linked by network relationships such as supply and demand, product path flows, and inventory holding centers.

Bioproduction Group has received contracts with several biotech firms to implement advanced prototypes of this research in biopharmaceutical manufacturing as they come online. The goal is to use this simulator to reduce biopharmaceutical inventory levels across the industry by 10% or more, while reducing risk across the manufacturing network. If successfully deployed in a large enterprise, it is believed that this inventory reduction would have a yearly return of more than $20mm per organization. The technology has the potential to be used across the biopharmaceutical industry to increase quality of care to the patient as well as reduce manufacturing costs. These goals have significant direct flow-on savings benefits to the hundreds of thousands of patients across the entire public and private healthcare sector.

BitSight Technologies, Inc.

Phase II Award No.: 1127185

Award Amount: $500,000.00

Start Date: February 15, 2012
End Date: January 31, 2014

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Sector: IT Applications

SBIR Phase II: Information Security Risk Rating

This Small Business Innovation Research (SBIR) Phase II project builds upon earlier work to develop an information security ratings service. When businesses connect their networks with partners or share data with them, they are often poorly informed about the potential risks they assume. Businesses have 3rd party relationships for a variety of operational reasons and these partnerships almost always involve sharing sensitive and confidential data. Data shared can be customer information, intellectual property, social security numbers etc. Businesses are worried about losing data through breaches in partner networks as they face the consequences - financial, legal, and regulatory. Existing risk management techniques are based on annual audits and only provide a snapshot of a partner's security posture. However, new vulnerabilities are discovered everyday and the industry needs a solution that enables a business to continuously monitor changing risk posture of all its partners and proactively manage assumed risks. The Phase II research objective is to build a scalable fully-automated ratings system. The research will focus on identifying and incorporating new data sources, improving the statistical properties of the ratings model, and making the ratings predictive of future behavior.

Historically, credit scoring has been a "cost and time-saving technology" that has provided tremendous value to lenders and borrowers alike by reducing costs, predicting future performance, and improving credit accessibility and affordability. Unlike credit scoring, no industry standard scoring service exists to rate business with respect to their information security risk. With Saperix's ratings service, businesses and government will have the potential to reap the same time and cost savings that lenders do from credit scoring services. If the research is successful, Saperix's solution would provide market incentives for improving security outcomes, which would be a significant change in how security investments are viewed by businesses.

Bluefin Lab, Inc.

Phase II Award No.: 0923926
Phase IIB Award No.: 1114405

Award Amount: $997,550.00

Start Date: August 15, 2009
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Semi-Automated Sports Video Search

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). The Small Business Innovation Research (SBIR) Phase II project objective is to commercialize a novel technology for indexing video. The company's approach automatically integrates information from speech, text, and video through algorithms that generate rich semantic indexes for video. The Phase I results show that this approach can be incorporated into a system that indexes video with high accuracy and at a fraction of the cost of currently used methods. Further, during the Phase I research, the company has identified a large and growing consumer market (sports video) in which the technology can be applied. The technical objectives of the Phase II proposal focus on working with such partners to roll out initial Bluefin-powered applications, such as content-based search and video-enriched fantasy sports. Such applications are currently not feasible because of the low accuracy of automated indexing methods and the high cost of manual approaches to indexing video.

Millions of hours of new video content are coming online every month, feeding an exploding demand and reshaping the nature of the Internet. Just as text-oriented search engines were necessary to empower users to find what they needed during the first phase of the text-centric Internet, a new generation of technology will be necessary to organize and effectively find content in the fast-approaching video-dominated era of the Internet. Bluefin Lab is pioneering a new approach to video organization and search by commercializing cross-modal algorithms developed in Academe. While this differentiated technology can be leveraged in several target markets, the company's initial focus is on sports media where it will power a unique experience for video search, video-enhanced fantasy sports, and other video-centric applications.

Cadio Inc

Phase II Award No.: 1127482

Award Amount: $498,395.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Sector: IT Applications

SBIR Phase II: System for Location-Based Mobile Consumer Analytics

This Small Business Innovation Research Phase II project aims to improve data mining technologies for location analytics. This project will focus on the analysis of semi-continuous GPS and/or WiFi-based location data generated by consumer mobile devices. The anticipated improvements would allow consumer insights professionals and advertising effectiveness researchers to better detect emergent patterns and to draw stronger inferences about consumer behaviors, preferences, and lifestyle attributes. The enhanced data mining system would utilize state-of-the-art pattern recognition and machine learning techniques to dynamically process and interpret location and other types of data. If successful, this research will impact the state-of-the-art in location analytics. This research has the potential to meet the need of consumer insights professionals to better understand how consumers behave, without the use of lengthy surveys. In a broader sense, this research aims to accelerate progress in the emerging field of location analytics.

This research can lead to the creation of a location analytics dashboard, similar to existing dashboards for web analytics. Most web analytics dashboards measure metrics such as site visits, page views and time spent for given online properties; analogously, the location analytics dashboard would measure visits by real consumers to physical locations. Such a location analytics dashboard could be offered on a subscription basis to companies that depend on consumer behaviors in the physical world including retailers, hotel/resort chains, restaurants, and travel companies. Such a dashboard would address a broad range of market research opportunities, from shopper loyalty research to store sitting to marketing effectiveness measurement. Additional future impacts of the proposed effort include the ability to integrate location analytics data into Geographic Information Systems for improved public safety, municipal planning and transit systems design.

Cohort FS

Phase II Award No.: 1152560

Award Amount: $500,000.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: IT Applications

SBIR Phase II: CohortFS: A Replicated, Parallel Storage System for Cloud Computing

This Small Business Innovation Research (SBIR) Phase II Project advances CohortFS, a replicated, parallel storage platform for cloud computing. CohortFS offers unique capabilities for data partitioning, secure data access and retention, and flexible management of storage at very-large scale, with seamless federation across geographically dispersed, separately-managed data centers. CohortFS improves the flexibility and simplicity of cloud storage management and facilitates uniform management of distributed volumes, whether local, remote, or in the cloud. The CohortFS model for transparent encryption protects data from storage providers and others in shared data center facilities, a key consideration for cloud data privacy and security which are consistently found to be the primary barriers to adoption of Infrastructure-as-a-Service (IaaS) and cloud storage.

The broader impact/commercial potential of this project includes advancement of standards-based storage infrastructure, advancement of both open source and proprietary storage technologies, and development of high-value software infrastructure that can be readily commercialized. CohortFS innovations in wide area replication and flexible data placement improve storage performance and manageability in public and private clouds. Using the cloud as an enabling medium, CohortFS translates advances in petascale data organization and secure, wide-area replication to broader markets and commercial sectors. By improving the economy and utility of storage at cloud scale, CohortFS widens the applicability of cloud computing, speeds its adoption, and deepens its impact - goals strongly supportive of the broader NSF mission.

Corporate Portfolio Management LLC

Phase II Award No.: 1127191

Award Amount: $500,000.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Sector: IT Applications

SBIR Phase II: Assessing Private Company Health Using Advanced Language Computing Techniques

This Small Business Innovation Research (SBIR) Phase II project will develop an software system directed at financial institutions (lenders and investors) that will provide them with actionable, realtime intelligence into the health of private companies. The technology being developed will scan and parse millions of structured, semi-structured and unstructured information sources searching for signals of a private company's health. Then, based on context, it will algorithmically process, categorize and assess the sentiment and strength of these disparate signals to offer a comprehensive, coherent and real-time view of a private company's health, its likely financing needs and best fit financing solutions from a financial institution's product portfolio. Using the company's line of products, financial institutions will be able to look at private companies in a fundamentally different, smarter, more scalable and data-driven way that empowers them to efficiently and intelligently make critical financing and capital allocation decisions. Specifically, they will have the potential to able to identify the right private companies in real-time and will be armed with intelligence they can use to offer them appropriate financing solutions.

The system's ability to process a diversity of structured, semi-structured and unstructured information sources and programmatically derive measures of company health would have profound positive effects on the precision, rigor and scalability of institutional lending and investment into private companies. Today, the private company financing market is built on highly imprecise and imperfect heuristics that result in high business loan default rates, or at its worst, bank failures as occurred in 2009. The downstream impact of this is that small businesses do not get the financing they need as evidenced in 2009 when, according to the Federal Reserve, only 40% of private small businesses that sought bank financing actually received the funding they needed. Per the Small Business Administration, businesses with fewer than 500 employees account for more than half the nation's employment and nearly half of GDP. As a result, it is critical that healthy private companies which are an economic catalyst have access to financing. Unfortunately, without credible, actionable, scalable and real-time information which distinguishes between healthy and unhealthy private businesses, financial institutions remain at an informational disadvantage. This increases their risk, which in turn hinders growing, healthy private companies from receiving the financing they need. If successfully deployed, the technology being supported by this proposal has the potential to make a significant impact in the marketplace.

CVISION Technologies, Inc.

Phase II Award No.: 0924549
Phase IIB Award No.: 1210965

Award Amount: $871,960.00

Start Date: September 1, 2009
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Real-time, Accurate OCR from Documents using Intra- and Inter-Frame Machine Learning

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project involves development of real-time algorithms for Optical Character Recognition (OCR) from documents. This real-time recognition (RT/OCR) system, to be fully developed under this SBIR award, performs recognition an order of magnitude faster than current commercial systems and will allow for real-time recognition that can be embedded on a system device and done at the time of capture. The RT/OCR system will also have no loss in recognition accuracy, and will, in fact, be more accurate for complex documents that include color, graphics, and multiple fonts. This technology, when successfully commercialized within Phase II of the SBIR award, could be deployed on every corporate MFP and digital copier device, converting corporate paper to searchable, electronic files and bringing us one step closer to the paperless office. The technology we intend to use in developing this real-time OCR recognition system is based on methods using Intra- and Inter-Frame Machine Learning. The algorithms to be developed are not, in any way, language specific and can run on virtually any platform (e.g. server or handheld device). The basic technology is completely different from the recognition kernels of current commercial OCR recognition systems.

This project is focused on developing revolutionary technology that will take OCR technology to a new level. This technology is designed to bridge the gap between paper and digital media, a much needed engine for Bill Payment Machine (BMP), document capture and document processing industry. The capture industry will grow to $2.42 billion in 2010, a CAGR of 16.4%. Real-time OCR for automated and semi-automated field coding addresses the needs of an industry that uses $14.5 billion/year of manual labor just in the US. RT/OCR will be part of a solution that addresses manual paper-based indexing for complex documents, potentially saving the industry and the government billions of dollars every year. This recognition technology, after being successfully developed and commercialized within the context of the Phase II research and development, can be generalized and extended to handle real-time video recognition, with application to autonomous vehicle navigation, aids for the visually impaired, and robotic factory automation.

ecoATM, Inc.

Phase II Award No.: 1152672

Award Amount: $500,000.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: IT Applications

SBIR Phase II: Automated and Self-Service Electronics Recycling Kiosk

This Small Business Innovation Research (SBIR) Phase II project is designed to commercialize a consumer self-serve, automated kiosk for the evaluation, buy back, and collection of used electronics directly from consumers. Prototype kiosks deployed during Phase I provided convincing proof of the feasibility of the baseline technical approach to the visual and electrical inspection technology, robotics, and the market. Financial metrics achieved were many multiples better than industry leading kiosks such as Coinstar or Redbox. Further R&D is required to achieve enough reliability in the automated inspection systems and the kiosk hardware to lead to the permanent removal the kiosk attendants in field that currently serve as the fail-safe mechanism in the current prototype systems. Broad commercial success relies on the development of a robust, designed-for-manufacturability (DFM), designed-for-serviceability (DFS), commercially reliable kiosk with a minimum retail field life of 5 years that incorporates needed improvements learned from Phase I including refinements to the visual inspection system and algorithms, electrical inspection system, test station robotics subsystems, ergonomics, GUI, and channel management systems. ecoATM also hopes to further develop the system's capability to offer personal data erasure and expand accepted device types to potentially include digital cameras, portable game players, printer cartridges, laptops, eReaders, and tablets.

The broader impact of ecoATM's patented system is that we finally achieved the threshold of consumer convenience and financial incentive required to inspire mass consumer participation in electronics recycling. Our pilot market tests indicate that we harvested 20 times more used phones than the next closest competitor in the test areas. As ecoATM scales nationally we will divert mass amounts of toxic eWaste from our landfills, and put huge sums of cash back in the hands of our customers and the retail locations hosting the kiosks, providing stimulus and incentive for these stakeholders to help forever alter the current wasteful lifecycle of consumer electronics. On average, each ecoATM collects enough eWaste to offset its own annual energy consumption after just 5 days placement resulting in 360 days of CO_2 offset. An average ecoATM collects over 7,000 phones per year, which according to the EPA calculator is equivalent to taking the CO_2 of 35 houses off the grid for a year. National and global media have taken notice of ecoATM already and even the United Nation's Low Carbon Leadership Program recognized ecoATM as one of the best ideas in the world for the reduction of CO_2 on a global basis.

emota.net

Phase II Award No.: 1058575

Award Amount: $499,992.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: An Internet-based Emotional Connectedness and Monitoring Device and Service for the Elderly

This Small Business Innovation Research (SBIR) Phase II research project will develop to market a new class of assistive technologies to improve the quality of life and well being of the elderly and to reduce the overall burden of the of aging on social and private healthcare systems. The company envisions the digital transformation of the aging process through the application of emerging technologies to change the context of caregiving from a medical to a familial one. Today's telehealth solutions focus on medical aspects and ignore social and psychological needs - a sense of contribution and connection for older adults. Research has shown that social isolation significantly increases the health risks. Conversely, even small increases in perceived emotional support result in significant improvement. The proposed platform has the potential to integrate with existing Health IT and telehealth systems to provide a holistic patient-centric solution, focusing not just on medical needs, but on the emotional and social aspects of aging.

Three powerful market forces intersect to create a new context in elder care: (1) Reducing rehospitalization has become a National priority, (2) New recognition that family caregiving needs to be an integral part of health care, and (3) Significant shift in age mass. One in five seniors discharged from hospitals is readmitted within the month. Research indicates that a "failing support system appeared to be the most important factor of influence in this respect." The American College of Physicians now encourages doctors to recognize the value of family caregivers as part of the care plan. Supportive social ties enhance physical and mental health among older adults whereas social isolation, loneliness and stressful social ties contribute to a higher risk of disability, poor recovery from illness, and early death. The company believes that there is significant market for consumer-oriented, social-based, self-care solutions that can integrate gracefully with professional medical monitoring solutions. If successful, the effort could kick start an ecosystem of similar, emotional connectedness solutions and technologies that could positively impact the lives of the elderly, and potentially other isolated groups as well.

EPIC Engineering & Consulting Group, LLC

Phase II Award No.: 1152694

Award Amount: $478,697.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Program Director: Glenn H. Larsen

Sector: IT Applications

SBIR Phase II: Implementing an Infrastructure Intelligence System for Water and Wastewater Utilities Using the Software as a Service (SaaS) Delivery Model

This Small Business Innovation Research (SBIR) Phase II project will build upon the successes of the Phase I research that showed the market need for an intuitive, location-based Infrastructure Intelligence System (Neptune), and demonstrated the technical feasibility to deliver a SaaS solution for water and wastewater utilities and public works agencies. Neptune represents a significant technological innovation in infrastructure information management; it will be a domain trend setter by delivering critical infrastructure information through one intuitive, powerful, comprehensive and affordable product. Current utilities software systems are complex standalone systems, typically used by technical experts. Information retrieval from these systems requires significant resources and technical expertise that are not available for most utilities. This project will design, develop, test and deploy production-ready Neptune
product that will provide instantaneous access to infrastructure information through Google Maps-like interface to a broad range of users from field staff to executive management. Neptune will remove the technology barriers of entry, enhance the capture and retrieval of enterprise knowledgebase, and help extend the useful life of our infrastructure.

The broader impact/commercial potential of this project lies in the urgent need for utilities and public works agencies that protect public health and safety to efficiently manage their aging infrastructure with budget shortages. Our nation's infrastructure deficiencies threaten public safety and welfare as well as our economic growth and competitiveness. The EPA estimates over 240,000 water main breaks and 170,000 sewer main breaks annually in the United States. Estimates for fixing our infrastructure run into hundreds of billions of dollars. To prioritize infrastructure maintenance, utilities must analyze diverse datasets including hydraulic models, GIS, SCADA, maintenance, emergency response and project documents. Available software are complex and expensive and presents a huge barrier to entry for most small and medium utilities. This is putting their residents and environment at increased risk. Through its simple interface and SaaS delivery model, Neptune will be accessible and affordable to all infrastructure agencies. It will communicate the importance of infrastructure investment to elected officials and public. Neptune has the potential to provide significant societal benefit by reducing infrastructure failures and guiding utilities towards proactive infrastructure maintenance practices.

GGL Projects, Inc.

Phase II Award No.: 1127567

Award Amount: $500,000.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Sector: IT Applications

SBIR Phase II: Software to Automate the Detection of Websites that are Fraudulent or Otherwise Harmful to Consumers

This Small Business Innovation Research (SBIR) Phase II project will develop software to automatically detect a broad spectrum of websites that are fraudulent or otherwise harmful to consumers. Much work has been done on specific software capable of detecting websites hosting malware or engaged in phishing. However, software does not yet exist which can detect a broader array of harmful websites, including those selling counterfeits, selling illegal drugs, and hosting weight-loss scams, to name just a few. The challenge in doing this involves selecting the right features of fraudulent sites which in isolation or combination are good indictors of a site's harmfulness. Using these features, a machine learning classifier can be trained using data on known harmful websites. Unknown websites can then be run through the classifier to evaluate their potential for harm. Additional challenges involve gathering sufficient data to properly train the classifier, making the classifier general enough to detect a range of harmful sites while still maintaining accuracy, and updating the classifier in real-time such that it can improve with ongoing human feedback and additional data.

The principal impact of this project is the protection of consumers from online fraud. Today, consumers lack reliable resources to evaluate unfamiliar websites. Most use familiar sites like Amazon or take a gamble on Google search results. These gambles frequently result in fraud. It is believed that there are now over 250 million websites and $100 billion lost yearly to online fraud. While the statistics cover many types of fraud, examples of risky sites include online counterfeiters, pharmacies, and retailers. The software developed in this project will greatly improve transparency around websites and protect millions from fraud. The technical achievements in this project involve the use of a vector space model in converting non-discrete features of fraudulent sites into useful data that can be inputted into a machine learning classifier. Additionally, this technology will include innovative feature choices, access to high-quality data, and the creation of a general classifier capable of improving itself in real-time and detecting a broad array of heretofore undetectable fraudulent sites.

Guidewire Group

Phase II Award No.: 1058606

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: Web Enabled System to Assess, Mentor and Accelerate Startup Businesses

This Small Business Innovation Research (SBIR) Phase II project will develop a Software-as-a-Service platform to provide Assessment, Discovery, Monitoring, Benchmarking, Comparison, and Promotion of early-stage companies, initially in the information technology and clean energy sectors, in order to provide scalable support with predictable outcomes for entrepreneurs. Guidewire Group is developing the underlying technology platform, assessment methodology, assessment training, automated work plans, curriculum, and portfolio management applications that enable startups and those that work with them to more effectively grow their businesses.

If successfully commercialized, the application stands to significantly scale the delivery of business development and advisory resources to early-stage companies and deliver predictable outcomes that improve a company's likelihood of success. By aggregating assessed data on startups worldwide, the application will provide a global context that enables startups to compete more effectively in world markets and to connect more efficiently with a global Innovation Ecosystem that buys and sells services from and to startup companies. Moreover, by delivering the platform in conjunction with a suite of best practices curriculum and a global community of entrepreneurs, the platform will enable organizations that support and incubate startup companies to more effectively manage and map the training of their companies.

Imagine Research, Inc

Phase II Award No.: 1026435

Award Amount: $508,000.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Sound-object Recognition for Real-time or Offline Systems

This Small Business Innovation Research (SBIR) Phase II project includes research and development of audio recognition and analysis software for offline and real-time sound recognition. Musicians and audio engineers have access to terabytes of music loops and sound effects. However, musicians are limited to searching for sounds using text-only keyword searches. This is a mundane, inaccurate, and exhausting process that ignores the files' actual audio content. The proposed solution provides a unique "find-something-that-sounds-like-this" search engine. Media production software and hardware is too complex, tedious, and labor-intensive for both novice and advanced users. The proposed sound platform adds capability that was previously missing - recognizing an input sound and automatically choosing the best parameters for the user. This project uses a signal processing and machine learning platform to perform novel experiments for classifying audio streams in real-time, improving recognition accuracy, and retrieving sounds from large collections. Commercial-quality software development kits for offline and real-time sound recognition will be developed. This project integrates state-of-the-art machine learning, digital signal processing, and information retrieval techniques.

If successful, the platform will be able to listen to an audio signal and understand what it is listening to - as human listeners can identify and classify sounds. This innovative technology will be licensed to audio and music technology software and hardware manufacturers. The platform is suited for long-term discoveries and innovation, with demonstrated commercial interest from biomedical signal processing, security/surveillance, and interactive gaming companies. In the first chosen market, (sound engineering) the platform will have direct cultural benefits for musicians, music hobbyists, and audio engineers. It will allow music creation and audio production to become a completely creative task - minimizing the tedious technical issues that hinder the creative process, and lowering the barriers to entry for novice musicians and creative professionals.

Intelligent Building Untility Conservation Systems

Phase II Award No.: 1058605

Award Amount: $508,000.00

Start Date: May 1, 2011
End Date: April 30, 2013

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Sector: IT Applications

SBIR Phase II: Isolating Specific Appliance Energy Usage from Whole Building Energy Consumption

This Small Business Innovation Research (SBIR) Phase II project will further develop the IBUCS' Utility Accountant electrical load disaggregation system and conduct performance trials in small commercial settings. Utility ratepayers need granular information to more effectively identify and mitigate inefficient appliances and activities. The new generation of smart electric meters currently being deployed for automated reading and time of use pricing are not be able to provide this level of detail. The signal processing algorithms evaluated during the Phase I study accurately isolate and quantify the power used by individual appliances from the aggregate power signal of the many appliances present on a leg or circuit. In the proposed project, additional enhancements will be made to the load disaggregation algorithm that will significantly improve system accuracy and reliability. Ratepayers will access a secure webpage to view their cost to operate specific appliances in their building or groups of buildings. The granular perspective provided will enable end-users to (1) calculate their own investment return periods for equipment repairs and upgrades, (2) develop data driven best practices for energy conservation, and (3) ensure that cost reductions are maintained over the long term.

The broader impact will occur when the technology is deployed throughout the residential and commercial segments as part of a new generation of smart meters. Commercially-available systems that directly monitor multiple specific loads are more expensive by an order of magnitude and inherently more difficult to install and maintain. Providing appliance specific load information has the potential to transform ratepayers' ability to conserve energy. The intended outcome of this Phase II project is to create an easy-to-use tool that will continually educate small business or franchise operators to reduce energy consumption. Nationally, Quick Serve businesses (i.e. fast-food restaurants, gas stations, and minimarts) account for ~10% of commercial buildings but are generally underserved by energy management companies due to their small size. IBUCS will provide a value-added service to the property manager through an energy management company that serves this segment.

IQ Engines, Inc.

Phase II Award No.: 0822713
Phase IIB Award No.: 1050700

Award Amount: $1,212,000.00

Start Date: August 1, 2008
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Mobile Visual Search Engine

This Small Business Innovation Research Phase II project will develop a biologically-inspired image search and recognition technology to provide rapid object information retrieval from a mobile phone camera. The end result is that potentially any object in the real world is now "clickable": a picture of an object provides a hyperlink to the Internet. The proposed system utilizes a new method for sparse, multi-scale image representation based on the monogenic signal, a 2D generalization of the analytic signal that is robust to image transformations.

By 2010, it is estimated that there will be over 1 billion mobile phones with cameras.The mobile phone is becoming an important connection between people and the digital world. The applications for mobile search technology are enormous and include national homeland security, product information retrieval (such as environmental ratings, pricing, or specifications), vision support for the blind, accessing object information for the disabled, and general purpose information retrieval including remote visual data analysis and inspection. Search technology has brought about many profound societal, educational and scientific benefits in the past decade. The proposed mobile image search technology will extend those benefits to a broader base of users and applications.

JAAL LLC

Phase II Award No.: 0956747
Phase IIB Award No.: 1238423

Award Amount: $488,242.00

Start Date: February 15, 2010
End Date: June 30, 2012

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Sector: IT Applications

SBIR Phase II: Making the Internet Safer One Website at a Time

This Small Business Innovation Research Phase II project will develop a novel security capability for protecting websites against hackers by providing preventive and early diagnosis services. Compromising websites is an emerging and profitable business for hackers, with devastating effects since such attacks: (a) hurt the compromised site directly, e.g. stealing stored credit card information, (b) hurt the website visitors, who are subjected to viruses infections or identity theft via code injection, which turns a legitimate website into a distributor of malware, and (c) hurt the reputation of the code-injected website, which is inevitably blacklisted by search engines. The project will develop the technology to: (a) assess the vulnerability level of a website, (b) detect security breaches in the form of code injection, and (c) expedite the recovery of a compromised website. the proposed work focuses on three key goals: (a) massive scalability through the minimization of manual intervention, (b) robustness and manageability by a carefully designed software-hardware architecture, and (c) continuous process of self-improvement and assessment of performance.

If successful, the impact of the proposed project has the potential to be immediate and direct: it promises to make website security more affordable, and not a luxury or an afterthought. Website security is an immediate and expensive problem: (a) it is estimate that most websites (over 60%) are vulnerable, (b) web-based malware spreading is taking the dimensions of a pandemic, (c) all of the reported 74M active websites are likely targets: from banks, to the local cookie store, and ultimately, (d) cyber-crime is a top national security threat according to the government. The proposed solution has the potential to make significant contributions in each of these four areas.

Kaviza Incorporated

Phase II Award No.: 1026875

Award Amount: $499,707.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Next Generation Virtual Desktops

This Small Business Innovation Research (SBIR) Phase II project will focus on scaling and developing a desktop-specific distributed grid to provide enterprise grade, highly available virtual desktop systems that are cost-competitive with PCs. To accomplish this objective the research and development will focus on three key areas. First it will focus on multiple ways to scale the solution including ways to distribute large desktop templates across the grid, develop self-managing software to automatically update, patch and repair the software that manages grid and support a hierarchy of grids that can be geographically distributed. Second, it will develop multi-tenancy mechanisms to securely house multiple customers on a grid thus making this a viable solution for managing and economically providing desktops as a service from a cloud. Finally, additional work to support multiple hypervisors and remote protocols will be developed to address market requirements for cost-effective virtualization technologies and to provide good user experience when deploying the solution across a cloud.

This takes advantage of a sizable and growing demand for virtual desktops that offer lower management costs and superior data security. Existing solutions on the market are 4 to 10 times the cost of regular PCs and require highly skilled personnel to operate, thus hampering their adoption. Kaviza's approach, if successful, reduces that costs drastically and makes it possible for the desktop IT staff who procure and manage PCs today, to be able to install and deploy proposed solution within their budgets. Kaviza's solution, if successfully deployed, also has the potential for broad economic and environmental impact. First, it can reduce PC power consumption by up to 75% making offices more "green". Second, its lower cost and simpler management will make it possible to broadly deploy computational resources and bridge the digital divide.

MEDKEN LLC

Phase II Award No.: 1058504

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Mammography Analysis and Reporting System

This Small Business Innovation Research (SBIR) Phase II project seeks to improve medical image analysis and reporting. The project proposes research and innovation on quality of diagnosis, richness of knowledge exchange, privacy and scalability of merging analysis and reporting of medical imaging for the detection of breast cancer. The company proposes a system which allows radiologists to focus on analyzing the image while the system automatically produces a report in the background. The reports are image-based, provide audience-specific levels of detail, and are backwards compatible to text-based reports. The SBIR Phase I project established the efficiency improvements that the proposed system can provide. In Phase II, this project will investigate cloud computing as a model for operating and delivering the company's mammography integrated analysis and reporting software. Cloud computing has proven to be a scalable and cost-effective means of delivering software services to customers and will thus be an important capability of health-care IT providers. However, the image storage and security requirements for medical images will necessitate improvements over existing cloud solution architecture. The Phase II project will develop new methods for delivering richer image-based reports and robust security via the cloud.

Breast cancer affects nearly one in eight women, at a substantial economic and societal cost. Mammography screening is the most effective way to detect breast cancer in its earliest and most treatable phases. However, there are many inefficiencies and quality problems in screening mammograms. While a shortness of radiologists specializing in mammography is driving up costs, there are significant false-negative rate and false-positive rates in screening mammography. This situation creates a clear opportunity for innovations that can provide increased efficiency while maintaining or improving quality. Changes in health-care legislation are yielding incentives for health-care facilities to transition to all-electronic systems. As they do so, many health-care facilities are embracing cloud-based delivery and Software-as-a-Service models. If successful, the Phase II project will continue with research and innovation for the delivery of an integrated analysis and reporting software that will improve the quality of medical image diagnosis while decreasing costs.

MetaFlows Inc

Phase II Award No.: 0923846
Phase IIB Award No.: 1212387

Award Amount: $750,000.00

Start Date: August 15, 2009
End Date: April 30, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Global Correlation Service for Network Security Applications

This Small Business Innovation Research Phase II project is directed toward fulfilling the need of business and Government organizations to more effectively monitor and protect their electronic networks. Network security devices (NSDs) such as Anti-virus, Intrusion Detection/Prevention, spam/phishing filtering, and bandwidth anomaly detection systems have become an integral part of our networks as they provide invaluable services in maintaining data integrity and confidentiality, while protecting the availability of computing resources. This research aims at significantly increasing the timeliness, accuracy and cost-effectiveness of NSDs in combating fast-changing and ever-more sophisticated network security attacks.

The programming and maintenance of NSDs is today a very significant obstacle to their wider adoption. The most common and significant complaints of existing NSDs users are (1) excessive amounts of false positive events (events that should not be generated) and the difficulty in analyzing security events (2) their extreme sensitivity to the timeliness of the security updates to catch emerging threats and (3) the expertise required in the installation, maintenance and operation of these systems. These obstacles limit adoption by many smaller companies that cannot afford to hire expert system administrators and network security analysts. MetaFlows seeks to capitalize on these deficiencies by providing ways to outsource this complexity. If successful, this research effort will inexpensively and thoroughly improve the manageability, accuracy and return on investment of many existing NSDs.

MiserWare, Inc.

Phase II Award No.: 1026899

Award Amount: $354,377.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Intelligent Software Power Management for Windows-based Systems

This Small Business Innovation Research (SBIR) Phase II project will develop and commercialize an intelligent software power management data center solution. The current default power management can seriously degrade server performance as much as 40% under certain loads. As a result, the default power management is currently not deployed and most servers in the data center are wasting significant energy. The proposed product encourages users to enable the unique power management capabilities to save up to 35% energy under normal load. The approach allows users to set the expected service-level and bound the impact of power management on server performance. For example, users can set a policy of < 10% performance loss and the software will save as much energy as possible without violating the policy.

Data center operators require energy efficient servers in the data center. Data centers in the U.S. and abroad provide the technological backbone for the Internet and e-commerce. As of 2005, data centers accounted for 2% of total U.S. energy consumption. Data center managers cite power consumption as their largest concern today since: 1) energy costs to run servers are now typically greater than acquisition costs; and 2) excessive energy use produces heat that reduces system reliability. If successfully deployed, the proposed approach has the potential to address an emerging market pain point and to make a significant positive economic impact.

OhMyGov Inc.

Phase II Award No.: 1127190

Award Amount: $500,000.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Sector: IT Applications

SBIR Phase II: Innovative Tools to Visualize Digital Media in Digital Era

This Small Business Innovation Research (SBIR) Phase II project will provide a visual analytics platform that helps visualize how information spreads on the Web through networks of news outlets and social media users. The supported research will extend the interactive visual analytic platform by incorporating better influence modeling, sophisticated propagation cascade models that consider the semantics of the entities and their changing dynamics through time, and new visual paradigms for clustered and grouped data. The interface will allow the end user to manipulate visual representations of how a single press release, news clip, Tweet, or marketing push triggers activity among journalists, micro-bloggers, etc. Public sector policy makers, communications professionals and researchers can use this platform to uncover paradigms in data dissemination, find new ways to influence information dissemination, better inform their leadership, and root out sources of erroneous information online. The Phase II research focuses on dynamic influence monitoring, development of robust propagation cascading models for different social media sites, and the use of visual analytics to understand multi-granularity information propagators. The three areas of research for Phase II are all complementary methods that attempt to characterize, measure, and understand the ubiquitous process of information spread and the influence of individuals in this process as well as allow the user to interact with the underlying data to enhance public outreach.

This grant will continue development of an interactive platform within which users can see and uncover patterns describing how messages are distributed across networks. The tool will locate key influencers, allowing communicators to see exactly how a message was distributed and ways to expedite message delivery during emergencies. Equally important is the ability of the tool to quickly uncover the source(s) and major purveyors of harmful misinformation on the Web. Data and filters further allow users to assess the size and demographic makeup of the audiences being reached enhancing governments interface with the public providing objective measures of the organization's effectiveness in penetrating traditional, new, and social media outlets. This insight will be used to better inform the organization and enhance public awareness of local, state and federal initiatives. Paired with the broader media analysis platform constructed earlier, the supported research will provide a comprehensive means of monitoring and measuring federal, state, and local municipality organizational performance.

Power Tagging Technologies, Inc.

Phase II Award No.: 1058573

Award Amount: $500,000.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Power Tagging Grid Intelligence for 21st Century Energy Applications

This Small Business Innovation Research (SBIR) Phase II project develops devices and systems to conduct two-way data communication using the electrical power distribution grid as the communications medium. The Phase I research provided information needed to optimize the devices, systems, and methods used, but also raised additional questions that need to be researched during Phase II. This effort includes the development of specialized high-order modulation techniques, filters and shields to allow the equipment to operate in a high-voltage environment, and specialized low-overhead communication protocols to accommodate the constraints imposed by the communications medium. If successful, an application platform for grid applications and a management model for distributed communications and intelligence will be developed. Typically, these needs are being addressed by overlaying a digital network of some sort over the power distribution network. Smart Grid initiatives in development today are complicated by the fact that no one digital communication technology is adapted to all the places and environments in which the Smart Grid must operate. The grid itself is always present wherever Smart Grid intelligence is needed, making on-grid communications potentially the simplest and most cost-effective medium for enabling Smart Grid communications.

Power Tagging Technology encourages a fundamentally different approach to Smart Grid implementation. Early efforts at using technology for demand management by engaging consumers have favored consumers at the high end of the economic scale, ones who live in newer subdivisions, and have the funds, skills, and interest to invest in personal energy management technology. Rural and inner city consumers benefit much less if at all from these programs. However, Power Tagging Technology has the potential to benefit all types of consumers equally through applications like high-resolution Conservation Voltage Regulation that reduces energy consumption and costs for wide-range of consumers. Power Tagging Technology is not only a communications mechanism, but it is inherently also a mechanism for monitoring the grid and inferring information about the electrical distribution infrastructure that is not readily available today. If successfully deployed, Power Tagging Technology has the potential for enabling whole new fields of research and development in Power Engineering and Grid Security.

Quantifind Inc.

Phase II Award No.: 1026493

Award Amount: $400,112.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Units-based numeric data extraction with knowledge of scientific context

This Small Business Innovation Research (SBIR) Phase II project aims to establish that a units-based approach to retrieving quantitative data from scientific and technical documents is a powerful alternative to keyword and document based search models. Keyword approaches to data extraction and contextualization are limited due to poor semantic contextualization and because quantities are often written in a wide variety of numeric and unit formats. The proposed approach to reliable numeric data extraction begins with quantity-intelligent indexing that recognizes many numeric formats and converts quantities to standardized base-unit tokens, to significantly enhance search recall over keyword approaches. The resulting number-unit pairs will anchor the index to enable efficient scientific exploratory search with high semantic precision, but without overly relying on sophisticated imposed semantic ontologies. Research will focus on a proprietary search-time data scoring algorithm that utilizes context-sensitive numeric spectra, to score otherwise ambiguous results based on probabilistic methods. This approach is expected to improve both precision and recall of contextual numeric data extraction. In turn, the resulting search engine will enable instant visualization and analysis of collective technology landscapes and trends, which will guide researchers in any area of technology represented by the indexed documents.

The broader impact of this project will be to enable reliable and efficient extraction of numeric data from diverse sources such as scientific literature and patent databases. These unstructured document sets contain a wealth of latent quantitative data which, if properly extracted and aggregated, can enable powerful modes of data exploration. The unit-based index and data-scoring algorithm are customized for an exploratory search model that will allow non-expert users to rapidly aggregate thousands of relevant data points, with simple keyword inputs and without laboriously opening and parsing individual documents. Researchers and students may thus explore data sets that were previously inaccessible, or known only to experts in a field. This will also contribute to knowledge discovery within large unstructured databases, since patterns and correlations between seemingly disparate variables can be immediately visualized. The platform will provide the capability to efficiently generate technology landscapes, anticipate emerging trends, and recognize competitive technical outliers. If successful, this will be valuable for high-tech industrial innovation including for engineers involved in R&D as well as business development executives and intellectual asset managers who focus on asset allocation, new technology ventures, prior art and patent infringement within a technical parameter space.

Red Lion Technology

Phase II Award No.: 1127464

Award Amount: $500,000.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Sector: IT Applications

SBIR Phase II: Building a Flexible, Technology Adaptive Architecture to Support Processing of Content by Knowledge Workers

This Small Business Innovation Research (SBIR) Phase II Project addresses the gap between the capabilities of today's semantic analysis systems and the accuracy requirements of knowledge workers (analysts and researchers) in language-sensitive fields such as public relations, foreign affairs, and crisis management. Knowledge workers in many organizations monitor and analyze print and web coverage for content of interest. When the volume of search results is large, some filter, classify and score the results using products or systems based on semantic analysis technology utilizing extensive libraries of words, patterns, and context-specific algorithms. However, users complain that these systems fall short of desired accuracy, missing rhetorical devices such as irony, sarcasm, metaphors, double entendre, and improperly interpreting connections between sentiment and topics. Users with high thresholds for accuracy thus turn to manual processes to either supplement or substitute for technology. Building upon Phase I work, the company will create and integrate a larger set of content processing modules and enhance a pluggable architecture to support quick insertion and testing of new modules in the content processing "pipeline."

Once commercialized, the system will enable more rapid adoption of technology by knowledge workers. In fields with high accuracy requirements, the need for human judgment has constrained technology use to discrete areas like search, while in subsequent processing steps, analysts must manually capture, classify, score, analyze, and report on the output. Feedback to date suggests the product can substantially enhance the productivity and effectiveness of professionals in these fields and that it addresses a number of frustrating gaps in the marketplace.

Sifteo Inc.

Phase II Award No.: 1026699

Award Amount: $435,886.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: Siftables - Distributed, Gestural Human Computer Interaction

This Small Business Innovation Research (SBIR) Phase II project aims to accelerate commercialization of a new human-computer interface (HCI) platform: Siftables. These are small, wireless, gesture-sensitive displays that act together as one interface. People can efficiently execute cognitive tasks through manipulation of groups of physical objects. These abilities find little purchase in both keyboard/mouse User Interfaces (UIs) and newer UIs with single displays.

The proposed platform provides a UI that can address a broad range of human-computer tasks, from media creation to data analysis to social communication. Historically, the entertainment domain has provided a profitable staging area in which to introduce novel UI systems - this market is large, has price flexibility, and its consumers have a demonstrated desire for novel interactions. This domain will provide a path to profitability, familiarize consumers with multi-object interfaces and allow the Siftables technology time to mature before other market opportunities are pursued. If successful, this system will allow the company to advance the state of the art of distributed operating systems and sensor networks.

StartUpHire LLC

Phase II Award No.: 1127357

Award Amount: $500,000.00

Start Date: August 15, 2011
End Date: July 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Matching Algorithms and Talent Acquisition System to Improve Start-Up Staffing

This Small Business Innovation Research (SBIR) Phase II project aims to create core algorithms for a Talent Acquisition System to pragmatically match candidates to startup job opportunities. Startup hiring needs are unique, and the market lacks an effective platform to accelerate and improve this core competency for company building. Generic search of a resume database does not sufficiently capture the unique fit requirements of startup employment nor return acceptable results. This research aims to incorporate (a) limited employer input of search criteria using a simple interface with (b) a broad range of normalized inputs, each individually scored for startup fit, to create a self-tuning algorithm for the search, discovery, and pairing of candidates to the unique needs of startups. The innovation in this approach is to create a system inherently weighted to both the hard and soft attributes of startup work/life. If successful, this effort will remove much of the guesswork by pointing employers to those most likely to excel in these opportunities. Data extraction, scoring techniques, and full text search will be applied to resumes, questionnaires, job search histories, social networking maps and search terms to feed the algorithm.

The broader impact of this project will be to improve the success rate for young companies by accelerating and improving the staffing of strong teams at every level in the organization. StartUpHire believes there is significant commercial potential for a startup centric career resource in the $6 billion annual U.S. online recruitment industry. Competitive approaches treat startup recruiting as identical to large company recruiting, yet experience indicates there is tremendous demand for an approach built around the unique needs of this community. Companies benefit by (a) focusing on talent which self-selects into this ecosystem and (b) algorithmically filtering these candidates using startup-specific success criteria. This research will create the first platform of its kind specific to startups, something employers have repeatedly requested. The proposed system will deliver both quality and speed biased to the needs of emerging growth companies.

Stone Ridge Technology

Phase II Award No.: 1058544

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Bioinformatic FPGA Appliance

This Small Business Innovation Research (SBIR) Phase II project will build an FPGA based Bio-informatic appliance for processing DNA sequence data faster, at lower cost and with less power. Over the last decade the cost of sequencing a genome has dropped by six orders of magnitude and the throughput of the process has increased by five orders of magnitude. The trend shows no sign of abating and industry experts expect the $1,000 genome mark to be reached in the next year. The combination of lower prices and higher throughput has lead to what is being called "the data deluge" or the "the data tsunami". Taming this deluge has become a major issue in Bio-informatics and a principle bottleneck to further advances. The objective of this Phase II project is to contribute a solution to the processing problem based on Field Programmable Gate Arrays (FPGAs), non-conventional computing platforms that operate at significantly higher efficiency measured in cost and power per performance unit.

The mechanism of genetic coding, identified by Watson and Crick in 1953, was one of the premier scientific advances of the twentieth century. It took twenty more years to identify a feasible approach to decipher the genetic code of a particular individual and twenty more to actually implement it. The first human genome was sequenced in 2003. By 2010 less than 1,000 humans have been sequenced but rapidly decreasing costs and increasing throughput promise that the number will increase exponentially and medical researchers foresee the day in the near future when the whole population will be sequenced as part of standard medical practice. The advances that will be enabled by partial or full sequencing of the population will bring a revolution to health care ushering in an era of personal genetic based medicine. If successfully deployed, the proposed approach has the potential to address the so-called data deluge and bring about significant savings in both processing time and power consumption.

Team Patent LLC

Phase II Award No.: 1057933

Award Amount: $500,000.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: Patent End-To-End (PE2E) Examination

This Small Business Innovation Research (SBIR) is directed to developing Patent End-To-End (PE2E) application examination capabilities that utilize cloud-enabled software services to enable the United States Patent and Trademark Office (USPTO) to collaboratively examine patent applications with enhanced validation, search, and office action support, resulting in higher quality and lower pendency. PE2E objectives include support for formalities review, search planning, annotation/collaboration, and office action formulation. The outcome of this investigation would potentially shift the way in which intellectual property is examined; providing examiners with tools to more deeply understand patent applications, collaboratively research prior art, and more easily document their assessments of the application prior art.

The U.S. economy relies heavily and increasingly upon intellectual property, and patents are one currency of this economy. As patents become more significant in the operations and outcome of U.S. businesses, it becomes increasingly important to assure that the patent examination system delivers high quality and timely examinations in order to support the next-generation of innovations. If successfully-deployed the proposed innovation has the potential to make a significant positive impact upon the US patent and trademark landscape.

Thousand Eyes

Phase II Award No.: 1058602

Award Amount: $500,000.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: IT Applications

SBIR Phase II: An Integrated Solution for Global Visibility and Security of Internet Services

This Small Business Innovation Research (SBIR) Phase-II project will develop a software-as-a-service product that provides actionable network intelligence to online businesses, enabling them to quickly identify and troubleshoot problems that affect their end users. Studies have shown that a poor end-user experience results in a tangible loss of revenue. Yet, online businesses are dependent not only on their own infrastructure, but on the state of the rest of the Internet as well. From the end user perspective, problems with the network infrastructure, third-party content provider issues, or traffic redirection attacks can result in sites being unavailable or slow. Hence, outside-to-inside monitoring of online services is critical for any Internet business if they wish to remain competitive. Unfortunately, existing products often treat the Internet as a black box. They are unable to capture where things have gone wrong or what could be improved inside the network. In this Phase-II proposal, the company takes a bottom-up approach to capturing end-user experience by focusing on understanding and measuring the components of the Internet infrastructure (such as DNS) that are responsible for data delivery. If this effort is successful, businesses will be able to ensure that their service is globally available, proactively identify performance bottlenecks at the network level, and be alerted immediately when under a traffic redirection attack.

Businesses that operate on the Internet expect data from monitoring services to be actionable. While some products provide actionable information regarding problem components in web pages, The company offers actionable insight into the network infrastructure that drives content delivery to end users. The impact of this technology is two-fold. First, the technology enables customers to improve content delivery to their end users, which leads to increased revenues. Second, the technology can protect businesses from falling prey to traffic redirection attacks, protecting both themselves and their users from financial losses due to fraud. If successfully deployed, the proposed innovation will address an emerging and significant pain point for online merchants and service providers alike.

Tokutek, Inc.

Phase II Award No.: 1058565

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: A Multithreaded Storage Engine Using Highly-Concurrent Fractal Trees

This Small Business Innovation Research (SBIR) Phase II project will apply multithreading techniques to provide multi-terabyte (and larger) high-performance databases in MySQL. The company has developed a highperformance storage engine for MySQL, which maintains indexes on live data 100 times faster than current commonly-used structures. The technology solves the problem of maintaining indexes on large databases in the face of high trickle-load indexing rates. In Phase I, the company developed a multithreaded bulk loader to solve the problem of how to load data quickly. The next significant research problems for large MySQL databases are to allow online, or "hot", schema changes in which, for example, an index can be added without taking the database down, and to use multithreading to speed up joins and reductions so that the large data sets can be queried quickly. In this project, the researchers will investigate the use of multithreading to support hot indexing and parallel joins reductions. If successful, multi-terabyte and larger databases will be manageable and fast on modest hardware, and the hardware will be scalable both with CPU cores and disks.

The broader impact of this work is driven by faster, cheaper, lower-power on-disk storage. Organizations that have very large databases will be able to use much less hardware, both saving money and reducing power consumption significantly. Currently many application areas do not employ databases because their performance is too slow. Speeding up databases by two orders-of-magnitude can help grow the market. Currently, many organizations fail to make good use of the data they have collected because they cannot manage it, index it, or query it fast enough to be useful. Applications in finance, retail, homeland security, telecommunications, and scientific computing will benefit from improved manageability and performance. As users' appetite for data continues to outstrip the availability of fast memory, organizing multithreaded queries on disk-based data for performance will continue to grow in importance.

txteagle Inc

Phase II Award No.: 1026853

Award Amount: $500,000.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Sector: IT Applications

SBIR Phase II: Large-Scale Analysis System for Mobile Crowdsourcing

This Small Business Innovation Research (SBIR) Phase II project seeks to create a new, innovative system to manage a highly-scalable, geographically-distributed labor force through wireless technology - what is refered to as " mobile crowdsourcing." The plunging cost of handsets and the introduction of prepaid call plans have allowed individuals throughout the world to have the ability to communicate and transact electronically. This project will create the infrastructure needed to provide wireless subscribers the ability to do work and earn money - leveraging today's mobile phone's ability to send, receive and display images, audio files and text. The system will: deconstruct a client's work into "micro-tasks;" preferentially route micro-tasks to individuals most likely able to complete them; statistically analyze completed work across individual responses to automatically reach a decision on when work is complete, and who has provided the most useful input; compensate workers in proportion to the value they have added; and, finally, reconstruct the completed task for the client, with a statistical assurance the work has been accomplished correctly.

The first application of this system will be for the business process outsourcing (BPO) industry. The company will integrate with several mobile carriers in Africa and South America to allow subscribers direct access to transactional BPO tasks including transcription, translation and text categorization. Communicating with workers directly through phones and emphasizing quality control on work, rather than worker will enable users to perform tasks when they want, where they want, and as they want. Automated compensation through existing mobile payment and airtime transfer systems will allow for much lower overhead costs. In addition to cost savings, however, clients who use this system to complete work will also have the benefits of: increased security (no one worker will be able to see an entire document or hear an entire audio recording), access to a scalable workforce (when "spikes" of work come through, labor can be seamlessly scaled up), and potential for very fast turnaround on work (micro-tasks can be done in parallel by many individuals, greatly reducing total time to complete a workload). Additional applications of the mobile crowdsourcing platform include data gathering related to local content and surveys, productivity tools for auditors, and mass reporting abilities following disaster-related events.

Urban Interactions Inc / Gigbin.com

Phase II Award No.: 0956817
Phase IIB Award No.: 1230255

Award Amount: $1,000,000.00

Start Date: January 15, 2010
End Date: July 31, 2014

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Program Director: Glenn H. Larsen

Sector: IT Applications

SBIR Phase II: Automated Mining of Worker and HR Preferences for On-Demand Job Matching

This Small Business Innovation Research (SBIR) Phase II project aims to improve the quality of on-demand job matching by applying data mining and machine learning techniques to natural language descriptions of job requests, worker reviews, and transaction history. The project will enable lasting job matches by predicting the needs, preferences and constraints of workers and human resource managers. Currently available methods of job matching rely primarily on keyword search, corporate personality assessment tests, or fixed ontologies. Such systems lack comprehensive learning and therefore have difficulty matching workers with jobs. This project approaches job matching with a bias-free learning model that learns from hiring successes, trains on real-world data, and adapts to new job verticals.

The broader/commercial impact of the project is a matching technology that optimizes workers' and employers' strengths, discovering matching opportunities overlooked by traditional search technologies. Online reputation-building through performance reviews can improve workers' ability to market themselves. The global matching technology permits nearly every skill to become marketable by matching workers with all features from every available job request. Natural language processing techniques, developed in the course of this project, have the potential to broaden the appeal of cell phone text-messaging as a comprehensive job-searching tool. Furthermore, the contextual approach to learning about workers and employers enables trends to be identified among users, and has far-reaching commercial implications in fields as diverse as medical research and e-commerce.

Veros Systems, Inc.

Phase II Award No.: 0923919
Phase IIB Award No.: 1152240

Award Amount: $719,468.00

Start Date: August 1, 2009
End Date: October 31, 2012

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Sector: IT Applications

SBIR Phase II: Adaptive Methods for Sensorless Estimation of Induction Motor Efficiency

This Small Business Innovation research (SBIR) Phase II project will develop and field-test a system for obtaining accurate on-line, in-service estimates of energy efficiency of industrial electric motors. The effort will further exploit the basic technology at the core of the condition monitoring & assessment (CM&A) product being developed by Veros Systems. Inc., and will become a key feature of that product. This monitoring technology is sensorless, in that only electrical measurements, i.e. voltages and currents available at the motor control centers, are utilized. No information from mechanical sensors, such as speed, torque, vibration or temperature, is necessary. Consequently, this reliable and effective CM&A technology is cost-effective and cost-scalable. The proposed approach to efficiency estimation is based on employing the raw electrical measurements that are collected for use by the existing CM&A product framework, and augmenting them with adaptive filters for accurate estimation. The Phase II research plan calls for the refinement of the online, in-service efficiency estimation algorithms defined in the previous Phase I effort.

The broader impacts of the project include awareness of the importance of energy efficiency in industrial motors, which account for about 25% of all electricity sold in the U.S. Widespread adoption of this energy conversion efficiency estimation technology could reduce the total energy consumption by industrial motors up to an estimated 18%. These energy conversion efficiency costs, together with the costs of maintaining electric motors and the costs of lost production associated with motor downtime are among the most significant controllable costs of industrial establishments. Even a modest adoption of more effective CM&A and efficiency estimation technologies would eliminate some fraction of this waste and have a significant impact on the U.S. economy, while enabling clients to reduce their energy costs, increase profitability, reduce fuel imports and lower greenhouse emissions.

Video Semantics LLC

Phase II Award No.: 1058428

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Multimodal Semantic Video Retrieval and Summarization

This Small Business Innovation Research Phase II project will develop contextual video segmentation and automatic tagging technology and software. In long video streams that contain one or more topics, the software automatically discovers the beginnings and ends of Contextually-Coherent Video Segments in each video. Moreover, Video Semantics' technology automatically assigns textual tags to each segment such that these tags describe the topic discussed in that segment. The tags assigned make all parts of the video easily searchable. Large video producers currently depend on manually segmenting their content into small segments and assigning textual tags to these segments in order to make them searchable. A short advertisement is then inserted before each segment. This manual segmentation and tagging process represents a significant pain point for content producers because it is labor intensive and not cost effective. Meanwhile, government agencies, which continuously monitor video content depend on speech recognition to spot specified keywords. This approach inflicts two pain points: (i) analysts have to deal with large number of false detections because the context in which the keyword occurs might be irrelevant, and (ii) if the keyword occurs in an important context, analysts still need to scroll back and forth into the video to find the beginning of the relevant segment.

Video Semantics' technology and products have the potential to efficiently address significant market needs. In addition to the commercial applications, the proposed technology will enable media monitoring agencies to perform their tasks more efficiently saving valuable analyst time and resources. Moreover, because Video Semantics' technology is language-independent, media monitoring agencies will be able to monitor more content in foreign languages without the need to develop language-specific technologies. The company will employ an indirect sales strategy via partnerships with software companies that develop media monitoring solutions and metadata generation tools. The company has identified its first customer and is working with them to integrate the contextual segmentation and tagging technology with their current media monitoring solutions.

VueLogic LLC

Phase II Award No.: 0923704
Phase IIB Award No.: 1144632

Award Amount: $734,026.00

Start Date: August 1, 2009
End Date: January 31, 2013

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Program Director: Errol B. Arkilic

Sector: IT Applications

SBIR Phase II: Predicting Behavior in Electronic Commerce Environments

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project involves the examination of consumer consumption behavior across multiple on-line domains to predict those items to be most likely consumed in the next interchange and the terms under which they will be consumed. The proposed innovation utilizes a persistent key technology to examine multiple attributes of identity to establish a unified identity that links individuals across multiple domains. Once linked the unified identity serves as the basis for the aggregation of consumption behavior (purchases, content, ads clicked through, invitations extended, etc.). The aggregated data establishes the consumer's digital footprint and serves as the basis for creating highly-predictive models. The models analyze the actual consumption behavior to establish consumption propensity and terms of consumption on an industry segment level. The results of the propensity models will be returned to the client at the time of interaction to make up sell / cross sell offers that are most likely to result in action by the consumer. The result for the client is increased revenue for the transaction and the result for the consumer is increased satisfaction through the relevance of the offer.

The broader impact of the proposed innovation involves three aspects: Accelerating economic expansion, identifying potential domestic terror threats and identifying potential on-line predatory activity. The ability for a retail or social network to identify the consumption preferences of their customers and offer those items during an interaction increases the likelihood that a customer will purchase the offered item due to its relevance. Such expansion of customer spending will assist organizations in increasing inventory turnover, improving sales and overall economic health. Identification of potential domestic terror threats through the examination of cross domain purchasing behavior of linked identities. Intelligence Services could establish purchase combinations that when combined could result in a potential treat and take appropriate early intervention action. Identification of potential on-line predators through the use of persistent key technology to highlight those individuals whose established identity on other domains is materially different from a current registration. This permits the organization to establish higher authentication requirements for those individuals and in so doing protecting itself and in the case of Social Media its members (specifically minors).

X5 Systems, Inc.

Phase II Award No.: 1026900

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: IT Applications

SBIR Phase II: A Search Engine for Antenna Design

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and launch a software tool that applies advanced AI algorithms to antenna design and optimization. Manual antenna design and optimization methods are time- and labor-intensive, limit complexity, and require significant expertise. Genetic algorithm (GA) optimization has demonstrated success at quickly finding effective antenna design solutions not ordinarily found through engineering intuition. To harness the power of these search algorithms currently, an engineer must be an expert in both GAs and Electromagnetics. In Phase I, feasibility of a highly-automated design approach where useful antennas can be generated without requiring significant guidance was demonstrated: the user simply inputs design requirements (e.g., RF performance, dimensions, etc.), and an automated optimization produces compliant designs. If successful, this technology promises to improve the performance and economics of future antenna applications for commercial and government customers.

The world is in the midst of an explosion in the number of new wireless, mobile, and RF systems - all of which rely on one or more antennas. Yet antenna design has changed little in the past two decades, with large up-front costs and slow, inefficient trial-and-error methods. X5 Systems is attempting to bring to market a next generation way to design antennas: one that is faster, better, cheaper. The commercial potential of the proposed software system encompasses application areas of interest to companies in mobile and wireless, RFID, and consumer electronics, as well as government agencies - especially applications that have exacting performance, schedule, and cost requirements.

Zienon, LLC

Phase II Award No.: 0924574
Phase IIB Award No.: 1157240

Award Amount: $750,000.00

Start Date: August 15, 2009
End Date: January 31, 2013

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Sector: IT Applications

SBIR Phase II: Tapping Finger Identification for Efficient Mobile Input

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to further develop the Tapping Finger Identification (TFI) technology investigated in Phase I. As mobile devices become more powerful and ubiquitous, text entry remains a major bottleneck to the wider adoption of mobile computing. To address this urgent need in lack of an acceptable solution, this TFI technology enables high-speed input in mobile devices and gaming applications using conventional typing techniques and keyboard layouts. In addition to demonstrating the feasibility of TFI during Phase I, the project will develop an IP strategy and a set of tools essential to future research and development. To date, one prototype has been implemented and a license agreement to commercialize some portion of the TFI technology was reached with an external partner. Completion of the Phase II research in two years will pave the way for commercialization of this innovative technology as we transition toward mobile computing.

The technology developed could potentially impact a broad range of application areas, including mobile computing, gaming, military, and mobile security. Mobile devices are becoming more powerful and ubiquitous. According to the IDC, convergent mobile devices grew 51% in 2007, and will grow from 124 million to 376 million in 2012. Data entry, however, remains a major bottleneck to the wider adoption of mobile computing. Most users are frustrated with existing input methods on portable devices, such as phones and mobile PCs. Much less a paragraph of text, simply entering a website's URL in a phone or mobile PC would be a burden for many. To address this urgent need in lack of an acceptable solution, the outcomes of this project projects the enablement of high speed, efficient mobile input using conventional typing techniques and keyboard layouts.

ZOOZ Mobile

Phase II Award No.: 1127163

Award Amount: $499,960.00

Start Date: December 1, 2011
End Date: November 30, 2013

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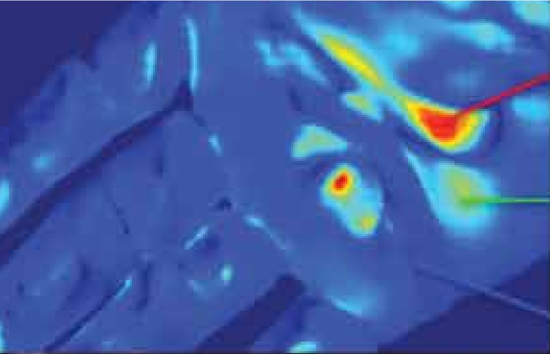
Program Director: Errol B. Arkilic

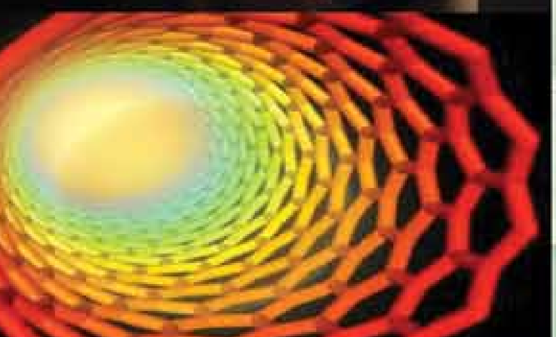
Sector: IT Applications

SBIR Phase II: An Interactive Music Analysis, Re-synthesis and Distribution Engine

This Small Business Innovation Research Phase II project aims to extend work in developing computational music systems that will automatically analyze and re-synthesize digital music for the purpose of transforming a linear and passive music listening practice into an interactive, expressive and creative music experiences. Building on the work in phase I, which focused on segmentation and user interaction, the company propose to extend the work in the following areas: Utilizing machine-learning techniques to extract instrumental content of musical segments; Developing automatic compositional techniques that would sequence annotated musical segments to create musically meaningful compositions; Developing visualization techniques for representing musical compositions; Develop a set of applications utilizing our technology, and implement a Cloud based service that would support seamless interaction with these applications. The intellectual merit of the project lies in the fundamental contribution to human knowledge in the areas for music perception and analysis, machine learning, automatic composition, user interaction, and visualization. The project will advance current knowledge in areas such as music information retrieval, music perception, machine learning, automatic composition, signal processing, visualization and cloud computing.

The proposed research would shed light on broader concepts such as human and artificial creativity and expression and the feasibility of utilizing artificial music intelligence as an enabler of novel forms of music creativity for children, novices and experts. The project will lead to broad impact in the public sphere by creating engaging and rewarding musical experience for users at all skill levels. Zooz's music intelligence engine will allow even those who believe they are not musically inclined to become engaged in expressive and creative musical experiences. As part of the project, we will continue to conduct workshops with educational and musical institutions where children and novices will interact and create music using the Zooz engine. High visibility public concerts will be conducted to bring the technology to the public eye. From a business perspective, the broad impact of the project is in providing a novel solution to the significant problems faced by the music industry today. The industry, which has suffered from a significant annual drop in music sales, is looking for new ways to monetize their content by engaging fans with music games, personalization tools and cloud-based musical interaction. Zooz Mobile will address these needs by providing an intelligent system that will allow fans to interact, personalize and share their favorite music in the Cloud in novel and expressive manners.






Nanotechnology, Advanced Materials & Manufacturing

Advanced Materials
Manufacturing Technologies
Nanotechnology

Absorbent Materials Company LLC

Phase II Award No.: 1127225

Award Amount: $510,182.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Sector: Advanced Materials

SBIR Phase II: Produced Water Treatment Using Animated Organosilicas that Rapidly and Reversibly Swell

This Small Business Innovation Research (SBIR) Phase II project will develop commercial systems to economically purify produced water streams. Produced water is the water that is co-extracted from oil and gas production and is often ten times as voluminous as the extracted hydrocarbon. Phase II efforts will be focused on scale-up to fabricate a 200 gallon-per-minute produced water treatment system to effectively mine hydrocarbons from the fluid. The process uses a newly developed nano-engineered organosilica that rapidly and reversibly swells when exposed to organics, yet is hydrophobic and does not absorb water. The organosilica material is unique that it acts as a nanomechanical sponge extracting dispersed and dissolved hydrocarbons. The captured hydrocarbons can be recovered from the silica and the sorbent material re-used. Successful development of these water purification systems will allow for an entire new mechanism for produced water management.

The broader impact/commercial potential of this project development is tied to the ability to treat numerous produced water streams which are currently difficult or expensive to treat, and to obtain a higher yield in the recovery of valuable products. Approximately 800 billion gallons of produced water must be managed annually in petroleum operations around the world. This treatment process will allow existing oil and gas production fields to meet existing or higher environmental discharge standards at a lower overall cost. The system will also reduce the impact or potential impact of the discharge of produced water in emerging markets with sensitive environmental concerns. From an economic impact the system will result in a higher yield for many oil and gas fields, by capturing for refinement valuable hydrocarbons which would otherwise have been disposed of as waste. Phase I results showed that 0.4-3.5% of a typical "waste" stream is composed of potentially valuable hydrocarbons which are not recoverable with existing technology. The recovery of these hydrocarbons, which are often the lightest and most energy-valuable compounds, such as toluene and octane, will increase the value of every producing well using this system.

Advanced Diamond Technologies

Phase II Award No.: 1058505

Award Amount: $486,112.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Low-cost Long-life Diamond Electrodes for Wastewater Treatment using Advanced Electrochemical Oxidation

This Small Business Innovation Research (SBIR) Phase II project will employ the boron-doped ultrananocyrstalline diamond (BD-UNCD) electrodes developed during the Phase I project to fabricate and characterize electrochemical cells and systems for the on-site generation (OSG) of advanced oxidants (chlorine-based mixed oxidants - hydrogen peroxide combined with hypochlorite - and sodium persulfate) and apply them to targeted water treatment applications. The primary research objectives are to determine the optimal conditions to generate oxidants and to establish the projected lifetime of the electrodes. BD-UNCD cells will demonstrate higher rates of oxidant production at lower costs and with greater energy efficiency than competing electrodes due to higher current densities and over-potentials for O_2 and H_2 evolution at the anode and cathode. The known difficulties with existing approaches of disinfection, such as the inadequate destruction of pathogens (Cryptosporidium), ineffective operation below 10°C, generation of large quantities of O_2 and H_2, and electrode fouling are expected to be mitigated substantially through use of BD-UNCD electrodes. Sodium persulfate (SPS) has been used as a highly effective oxidant capable of oxidative destruction of recalcitrant organics such as in oil-contaminated sea water. BD-UNCD technology will dramatically reduce the cost and increase flexibility of OSG water treatment using SPS.

The broader impact/commercial potential of this project is the development of a safer, cheaper, more environmentally friendly technology to generate "green" oxidants using diamond electrodes that can be used for a number of water treatment applications including purification, disinfection, and remediation. The market for chlorine-based disinfection systems alone is $20 billion with a correspondingly large impact on human health and national security issues associated with transporting vast quantities of hazardous materials. Overcoming technical barriers that have prevented diamond from being used for oxidant generation will require advances in the synthesis and large-scale manufacturing of diamond thin films that will impact other applications of this material. The electrochemistry of diamond is not well understood in the conditions needed for OSG. Better understanding of these reactions and the technological trade-offs between cell design and electrode geometry will impact related applications including the development of compact systems for third-world potable water generation, small scale desalination, the energy efficient electrochemical synthesis of new materials and other point-of-use applications of advanced oxidants. Large scale on-site generation of persulfates will enable highly effective treatment of refractory organics found in oil contaminated sea water and waste water associated with bitumen refining.

Advanced Photonic Crystals, LLC

Phase II Award No.: 1058055

Award Amount: $499,873.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Hydrothermal Growth of Potassium Beryllium Fluoroborate (KBBF) for Deep UV Nonlinear Optical Applications.

This Small Business Innovation Research (SBIR) Phase II project will develop a commercial growth process for single crystals of KBe2BO3F2 (KBBF) using hydrothermal techniques. The compound was developed 10 years ago and shows exceptional promise as a deep UV non-linear optical (NLO) material. The sub-200 nm region is presently inaccessible for solid-state lasers, and optical components functioning at these wavelengths are limited. KBBF has excellent deep UV properties and shows great promise for laser applications like frequency doubling and wavelength mixing. A previous flux growth method for the crystals demonstrated excellent performance in deep UV lasing, but the material is very difficult to grow in the required single crystal form. Additionally, China has embargoed crystals grown by this method, as well as the process, so KBBF crystals are currently unavailable outside of China.

The broader impact/commercial potential of this project will be to continue to develop the hydrothermal method for growth of single crystals for optical applications. NLO materials are vital for the development of solid-state lasers with wavelengths below 200 nm for use in photolithography, micromachining and spectroscopy. The availability of KBBF crystals will also enable new technologies, such as standoff explosive detection. This technology will help the rebirth of the advanced materials industry in the United States. The crystal growth industry has moved nearly completely offshore, leaving the United States vulnerable in terms of advanced applications, with a shrinking pipeline of new strategic materials, especially in the field of optics. This field is particularly dependent on new materials and the US is in serious danger of losing our once-substantial competitive edge. Additionally, a postdoctoral student will be supported through a subaward to Clemson University, and will become part of the next generation of materials scientists and engineers in this country.

Agiltron Incorporated

Phase II Award No.: 1058570

Award Amount: $487,872.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Prakash Balan

Sector: Advanced Materials

SBIR Phase II: High Performance Supercapacitors Based on Nano-engineered Electrodes

Supercapacitors are indispensable energy storage and conversion devices with wide applications. Agiltron is developing a next generation EDLC supercapacitor that has more than two times the energy density and ten times the power density of the best conventional carbon-based supercapacitors. In Phase I we successfully fabricated the novel TiC/TiC-CDC core/shell nanostructure electrode, demonstrating the predicted 2X energy density in a test device. We then calculated the power density, predicting a 10X improvement over conventional supercapacitors. This combination of high energy density and high power density has not been attained before. In Phase II, we plan to produce supercapacitor prototypes, and optimize, standardize, and scale up the material fabrication process, including the investigation of roll-to-roll manufacturing of the proposed supercapacitor electrodes. At the end of Phase II we will have developed a prototype process capable of commercializing these high performance supercapacitors.

Supercapacitors are indispensable energy storage devices because their performance bridges those of batteries and conventional capacitors. The most significant challenges for supercapacitors are to increase their energy density and power density. Our proposed core/shell nanostructured supercapacitors address these two challenges simultaneously. The proposed superior supercapacitors will meet the needs of quickly growing markets of hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEVs), city buses, rails (heavy rail vehicles, tramways and metro), and renewable energy systems (wind power and solar power) to satisfy the peak power needs in a cost-effective manner that battery cannot provide. Other potential domestic applications include UPS systems, cell phones, PDAs, medical devices, AMRs, notebooks, communication equipment, sensors, actuators, car audio components, welding machines, solar lighting, inverters, cameras, copy machines, and power supplies. Core/shell nanostructured materials offer the potential to provide multifunctional application in supercapacitors, solar cells, and batteries. The success of this program will stimulate enthusiastic academic and industrial interests for using core/shell nanostructured materials to address significant energy problems, and thus open new horizons that have not been imagined before.

Agiltron Incorporated

Phase II Award No.: 1127258

Award Amount: $499,952.00

Start Date: November 15, 2011
End Date: October 31, 2013

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Program Director: Prakash Balan

Sector: Advanced Materials

SBIR Phase II: High Energy Density Nanodielectrics for Commercial Pulse Power Applications

This Small Business Innovation Research (SBIR) Phase II project focuses on developing a new category of high energy-density nanocomposite dielectric materials for use in high pulse power capacitors. The approach is to bring together nanostructures in a polypropylene matrix to form a novel nanocomposite material with high effective dielectric constant, high breakdown voltage, and low dissipation factor. In Phase I we successfully produced a nanocomposite dielectric material by uniformly dispersing chemically modified ferroelectric nanoparticles into a polypropylene (PP) matrix to form a novel material with high effective dielectric constant and high energy density for capacitor applications. This high nanoparticle content film exhibits a charged energy density of 6.85 J/cm3, a dielectric constant of 31.97, and breakdown voltage of 220 MV/m. This combination of high energy density and high dielectric constant has not been attained previously from either commercial PP or PP nanocomposites dielectric films. The Phase II effort is directed towards developing a prototype process suitable for commercializing these high energy density nanodielectric films for capacitor applications.

The broader impact/commercial potential of this project is the introduction of new highperformance nanocomposite dielectric materials. The proposed materials could be employed in commercial high-power pulse, fast pulse, and high-energy density capacitors, resulting in reduced size, reduced weight, and improved circuit design. The proposed nanocomposite dielectric technology can make a needed difference in a variety of industrial fields. The commercial opportunities include all high energy density electronic devices and packaging for medical, communication, transportation, and power distribution systems, in products such as implantable and portable defibrillators, lithotripters, medical and commercial lasers, pulse forming networks, A.C. motors, ultrasonic transducer exciter, strobe lighting, and acceleration and energy recovery systems of automobiles. The proposed nanocomposite dielectric materials can also be used in military and aerospace electronic devices. In addition, this new class of nanocomposite materials may enable new devices besides capacitors that need the unique properties of this novel material system.

Arbor Photonics

Phase II Award No.: 1058538

Award Amount: $444,892.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: High Power Pulsed Fiber Laser for EUV Lithography

This Small Business Innovation Research Phase II project has the core objective to develop a modular, laser power scaling concept based on recent innovations in high efficiency fiber lasers. The proposed concept uses large mode area, chirally-coupled core fiber to construct high power, pulsed fiber laser modules that can be spectrally combined into a single, collinear beam delivering multi-kilowatts of average power. Power scaling of a laser source with characteristics appropriate for the generation of extreme ultraviolet (EUV) radiation is a key obstacle to the technical maturity of EUV lithography. EUV lithography is the leading candidate for high volume manufacturing of the next generation of semiconductor integrated circuits with critical dimensions of 22 nm or less. The Phase II effort builds on the successful Phase I feasibility and design results by developing the critical components and constructing a prototype laser module. Results expected from this work include construction and characterization of key laser components capable of withstanding high laser peak powers and demonstration of a breadboard, prototype fiber laser capable of producing pulse energy of 1 millijoule or more with pulse lengths of 5-30 nanoseconds at pulse repetition rates in the range of 50-200 kHz.

The broader impact/commercial potential of this project is the continued advancement of semiconductor integrated circuit performance. A key metric in this advancement is the minimum critical dimension that can be realized in the manufacture of these devices. Advances in lithography have enabled a decrease of approximately 30% in this dimension every two years, which has led to a doubling every eighteen months in the number of transistors on an integrated circuit. This trend, known as Moore's Law, has fueled an explosion in the processing power, storage capacity, efficiency and affordability of microelectronic devices. EUV lithography, currently under development, is the critical manufacturing technology that is needed to sustain this trend on the five to ten year horizon. Development of a power scalable laser, operating in the nanosecond pulse regime, is a critical element in the practical realization of EUV lithography. Success in this endeavor will help to deliver continued advances in microelectronic devices that benefit fields of study and industry as diverse as genetic engineering, telecommunications, computer engineering and transportation.

Ceralink Inc.

Phase II Award No.: 1127538

Award Amount: $515,857.00

Start Date: November 15, 2011
End Date: October 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Ultra High Temperature Microwave Processing of Ceramics

This Small Business Innovation Research (SBIR) Phase II project addresses the need for breakthrough technologies in the production of ultrahigh temperature (UHT) ceramics, including nanograin structures, with improved performance-to-cost ratio. UHT ceramics are often challenging to densify. The development of UHT microwave assist technology (MAT) furnaces will dramatically improve the commercial applicability of UHT ceramic products through lower temperature densification and faster heating cycles. MAT, the combination of microwaves with radiant heat, is proven to enhance diffusion, leading to finer grained microstructures. This project will extend the use of MAT to temperatures above 1700 deg. C, into the range of sintering temperatures for UHT ceramics. A prototype UHT MAT furnace will be designed and built, capitalizing upon in-house MAT system design expertise and research results from Phase I. Proprietary MAT-modeling software will assist with optimizing furnace design and process efficiency. Selected UHT ceramics will be studied to demonstrate sintering with the prototype. Three current industrial UHT ceramic manufacturers, who expressed strong interest in using MAT for sintering products, will collaborate on the project.

The broader impact/commercial potential of this project includes performance enhancements at reduced processing costs, and growth in the use of ultrahigh temperature (UHT) ceramics. Expanded uptake of UHT ceramics will benefit a wide array of manufactured products in electronics, automotive, and aerospace applications. The process of sintering UHT ceramics is extremely energy-intensive. UHT microwave-assist technology (MAT) processing will reduce energy consumption and green house gas emissions by 50-80% for UHT ceramic production. This process may replace pressure-assisted methods, by combining MAT with techniques such as variable rate sintering. MAT may also decrease the use of sintering aids to improve erosion and wear resistance, and high-temperature strength. This faster process enables just-in-time manufacture and enhances competition with respect to foreign competitors. Finally, the UHT MAT furnace technology will lead to new and value-added products, through property improvements from finer grain sizes and cost reduction. This will position American manufacturers for new revenue opportunities and job growth.

Chemat Technology Inc.

Phase II Award No.: 1026215

Award Amount: $499,997.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Thick Piezoelectric Films with Dielectric Constant above 3000

This Small Business Innovation Research (SBIR) Phase II project aims to develop high dielectric constant (high-K) thick film for high-frequency ultrasonic transducer. Thick piezoelectric film technology is very attractive for the fabrication of thin piezoelectric element in high-frequency ultrasonic medical imaging applications. However, it is challenging to process high-quality piezoelectric film with thickness in the range of 10-20 micrometers. In addition, the film needs to demonstrate dielectric constant of 3000 or higher due to the need of electric matching in fabricating array transducers. In previous Phase I project, a piezoelectric thick film with dielectric constant higher than 3000 was demonstrated. In this Phase II project, the high-K thick film will be utilized to develop miniature high frequency single element and linear array transducers for Intravascular Ultrasonic (IVUS) imaging applications.

The broader/commercial impact of this project will be the potential to provide high-K thick film to enable the application of miniature high-frequency ultrasonic transducers. IVUS is a medical imaging methodology using a specially designed catheter with a miniaturized ultrasound probe attached to the distal end of the catheter, which is inserted into the heart or into a coronary vessel for visualizing the vessel and heart structure. This project is expected to further miniaturize the ultrasonic transducer mounted on the catheter and provide improved resolution. With this anticipated catheter, surgeons may view the arteries of patients more clearly and spend less surgery time. Plus, the smaller size will make the procedure less invasive. In addition, this technology can also be used in other applications such as Radio Frequency (RF) filters for cell phone, ultrasonic valve and tuning devices, liquid delivery and droplet ejectors, chemical and biomedical sensors etc.

Composite Technology Development, Inc.

Phase II Award No.: 1026873

Award Amount: $464,124.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Novel Fire-Resistant Toughened Benzoxazines

This Small Business Innovation Research (SBIR) Phase II project seeks to develop and demonstrate flame-resistant, polymer-composite materials based on novel benzoxazine resin chemistries. In the Phase I project, low-viscosity benzoxazine resins were synthesized and composite formulations prepared that exhibit suitable processing characteristics for use in composite manufacture, as well as good mechanical strength and flame resistance. These successes were achieved through the development of polymer synthesis techniques, and validated by the subsequent fabrication and testing of continuous fiber-reinforced composites. For example, the Phase I results showed that these new polymer formulations offer significantly reduced processing temperatures, which simplifies composite manufacturing processes and reduces tooling costs. In addition, the fiber-reinforced composites produced using these materials exhibited 15-20% higher tensile strengths and 50% higher toughness values as compared to composites fabricated using the as-synthesized (i.e., not toughened) material. This finding is important and shows that composites with strengths comparable to those of epoxy-based systems, but with superior flame resistance, can be achieved with these new materials.

The broader impact/commercial potential of this project will initially be in the electronics and aerospace markets. Flame-resistant polymers and composites are becoming increasingly important systems in both of these industries. In each case, the use of fire-resistant materials offers enhanced public safety, while also improving the overall performance of the systems in which they are used. The value of high-strength flame-resistant materials is perhaps most evident in the civil aviation industry. In this instance, the transition to composite materials offers a significant weight savings, with reductions in weight accounting for a large percentage of recent improvements in aircraft fuel efficiency, while also enhancing the flame resistance of aircraft structures. In addition, the use of advanced materials is expected to increase steadily in electronics applications over the next 10 years, and the further development and commercialization of benzoxazine resins will provide the users of this technology with enhancements in both fire safety and system-level performance.

Creative Electron, Inc.

Phase II Award No.: 1026864

Award Amount: $499,913.00

Start Date: August 15, 2010
End Date: July 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Lead-Free Sintering Adhesives for Electronics Thermal Management

This Small Business Innovation Research (SBIR) Phase II project will further the development of lead-free transient liquid phase sintering (TLPS) adhesives with very high thermal and electrical conductivity for packaging high-power semiconductor devices. Conductive adhesives are typically used for low-cost assembly, but these materials represent the weakest point in the thermal path. To address this issue, TLPS conductive adhesives form metallurgical bonds with the adherent metallization and can provide an order of magnitude or more improvement in thermal performance versus existing adhesive technologies. These low-cost, lead-free materials are designed as drop-in replacements for existing manufacturing processes. During this Phase II project, the focus will be the formulation, characterization, and qualification of lead-free TLPS adhesives for high-volume semiconductor device manufacturing. The primary objective of this project will be the demonstration of an order of magnitude improvement in effective thermal conductivity compared to commercial conductive adhesives for electronics packaging. Advanced characterization techniques, along with durability studies, will be instrumental for bringing these materials to a readiness level suitable for market penetration.

The broader impact/commercial potential of this project is the development of new semiconductor die-attach materials suitable for the low-cost packaging of high-power semiconductor devices. A number of industries are aggressively developing innovative product lines centered on the concept of energy efficiency and higher performance; these include hybrid electric vehicles (HEVs) in the automotive sector, high-brightness light emitting diodes (HBLEDs) in commercial lighting, and concentrator photovoltaics (CPVs) for utility-scale electricity. Further, next-generation silicon devices, particularly those based on stacked-die architectures, also require improved conductive adhesives to fully enable their performance benefits. At present there exist no RoHS-compliant products that can satisfy all the needs identified by these markets in a cost-effective fashion. Yet these needs are becoming more urgent as a multitude of electronic devices reach the limits of today's heat dissipation technologies. The primary products which will result from this Phase II effort are advanced thermally and electrically conductive adhesives that can meet the thermal management requirements of advanced semiconductor packages while lowering their cost of manufacture.

ECOSIL Technologies LLC

Phase II Award No.: 1152518

Award Amount: $475,554.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Advanced Materials

SBIR Phase II: High-Performance Metal Pretreatments

This Small Business Innovation Research (SBIR) Phase II project aims to develop a chromate- and phosphate-free metal surface pre-treatment product that reduces cost, and provides significant environmental and health benefits. Iron and zinc phosphate chemicals are currently widely used in surface treatment processes, which require from 7 to 10 process steps, consume energy to heat treatment baths, and produce a large quantity of waste that must be treated. This adds cost, and results in phosphate discharge to the environment. Based on the Phase I project, a chromate- and phosphate-free pre-treatment chemical will be further developed in this project. This chemical reduces the number of pre-treatment process to less than 5 steps, can be used at ambient temperature, and produces 90% less waste. It is expected to demonstrate enhanced performance in corrosion protection and paint adhesion over similar products.

The broader commercial impacts of this project will be to dramatically reduce cost, complexity and negative environmental impact of metal surface pretreatment in manufacturing processes without compromising performance. Potential applications will be in automobile, aerospace, steel (coil coatings), consumer electronics, appliance, and many other industries. An important societal impact will be the better protection to workers in plants, as this process is not toxic and does not require elaborate waste disposal procedures. This project will also enhance the scientific understanding of mechanisms by which pretreatments contribute to the protection of metals.

Ecovative Design LLC

Phase II Award No.: 1058285

Award Amount: $401,387.00

Start Date: March 1, 2011
End Date: February 28, 2013

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Sector: Advanced Materials

SBIR Phase II: Method of Disinfecting Precursor Materials using Plant Essential Oils for a New Material Technology

This SBIR Phase II project seeks to further develop, and demonstrate at scale, a biological disinfection process that has exhibited superior microbial inactivation to steam pasteurization at a lower cost. This process leverages dilute concentrations (0.5-0.875% by volume) of plant-derived phenols and aldehydes to inactivate lower level fungi and bacteria found on agricultural byproducts (seed husks and hulls). The application focus for this demonstration is a novel material technology that converts lignocellulosic waste into a high performance, low cost replacement for synthetics (plastics and foams) using a filamentous fungus. This biological disinfection process can reduce process energy consumption by 83% and system capital expense by upwards of 50%. This project will fully quantify the efficacy of this disinfection process at scale (production volumes) as well as analyze the integration of this technique into a mycological material production facility that is presently addressing the protective packaging industry. Batch and continuous systems will be explored, and a comprehensive economic model will be developed based on the results. The mycological materials that are produced under this demonstration will be compared with materials fabricated with the existing pasteurization system, and samples will be evaluated by customers to ensure product adoption.

High-embodied energy disinfection processes, autoclave sterilization or pasteurization, are ubiquitous within industries such as agriculture, food processing, and biotechnology. These methodologies are implemented to reduce or remove background bioburden (bacteria, yeast, mold) that can be detrimental to downstream processes due to contamination. Mycological materials production represents such a process since raw material contamination results in product loss and added labor. The plant essential oil (PEO) disinfection technique was proven under the Phase I research to offer a comparable process time to steam pasteurization and superior disinfection efficacy; thus this technology could serve as a drop-in replacement in some industrial applications. This process minimizes capital equipment and operations costs due a reduction in system complexity and energy consumption. In regards to the production of mycological products, this disinfection process bolsters the process robustness by extending contaminate inactivation periods which promotes rapid mycelium colonization or a reduction in incubation time. Therefore new market opportunities for mycological materials can be addressed while further supporting the business case for regional manufacturing using domestic agricultural waste as raw materials. Finally, the benefits obtained from this novel disinfection process permit an accelerated deployment and development of turnkey production systems to displace synthetic materials.

Ecovative Design LLC

Phase II Award No.: 1152476

Award Amount: $465,604.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Advanced Materials

SBIR Phase II: Using Mycelium as a Matrix For Binding Natural Fibers And Core Filler Materials in Sustainable Composites

This Small Business Innovation Research (SBIR) Phase II project seeks to further quantify the mechanical performance of mycological bio-composites that address the automotive and structural core industries, while concurrently scaling and demonstrating material production. The engineered composites market continues to grow steadily because of the high strength-to-weight and stiffness-to-weight ratios of these systems, as compared to conventional engineering materials. Engineered woods are ubiquitous in the construction and furniture industries, but due to domestic indoor air quality regulations (Toxic Substances Control Act), these materials are being phased out or are forced to use expensive formaldehyde-free adhesives. Similarly, the automotive industry is under regulatory pressure in Europe to find alternatives to fire-retardant foams that cannot be recycled due to inorganic filling agents. The technical results from the Phase I effort have demonstrated bio-composite materials which can compete both economically, and on mechanical performance, with the aforementioned competitors, while meeting these legislative demands. A preliminary cost analysis based on the process economics of our existing production facilities projects retail costs 45% and 35% below the current state-of-the-art in the automotive and furniture industries, respectively. We will work with key industry partners to meet performance metrics and demonstrate quality pilot production.

The broader impact/commercial potential of this project would be a customizable bio-composite for a broad range of markets, including automotive, transportation, architectural, furniture, sports, and recreation. These materials are truly sustainable, since both the laminates and cores used in the sandwich structure consist of renewable materials. They also require significantly less energy to make than other biocompatible composites, because the material is grown instead of synthesized, and the material is completely compostable at the end of life. The outcome of the proposed development and demonstration will ensure that the bio-composite properties meet the requirements for the target markets. Furthermore, over the course of this grant, and in cooperation with Rensselaer and Union College, we will demonstrate and scale the best manufacturing processes to a pilot stage capable of manufacturing high volumes of quality product. Since these materials leverage regional lignocellulosic byproducts from domestic agriculture and industry, a regional manufacturing model is presently being pursued to reduce transportation and feedstock costs. This will not only bring additional value to U.S. agricultural markets, but will spur rural economic development through domestic manufacturing. Finally, these advanced biological materials represent a new paradigm in manufacturing, offering safe, biodegradable alternatives to traditional petroleum-based alternatives.

Electron Energy Corporation

Phase II Award No.: 1026786

Award Amount: $500,000.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Synthesis of Hard Magnetic Nanoparticles and Fabrication of Micromagnets for Microelectromechanical System (MEMS) Applications

This Small Business Innovation Research (SBIR) Phase II project aims to develop anisotropic hard magnetic nanoparticles and nanoflakes based on rare-earth transition metal compounds, which can be agglomerated by screen printing and tape casting into micro- or sub-millimeter permanent magnet structures. The excellent magnetic properties, small size and particular morphology of the nanoparticles and nanoflakes will allow for high magnetic performance with dimensions that bridge the current gap between the permanent magnet thin films (about a few microns) and micromachined permanent magnets (typically larger than 500 microns). This project is expected to (1) synthesize permanent magnet nanoflakes and nanoparticles with magnetic properties comparable to those of the bulk counterparts, (2) prepare monolithic isotropic and anisotropic hard magnetic thick films by screen printing, (3) fabricate solitary isotropic and anisotropic hard magnetic thicker films or structures by tape casting, and (4) develop prototypes of sub-millimeter permanent magnet structures for terahertz (THz) devices and micro-undulators.

The broader/commercial impact of this project will be the potential to provide stable permanent magnet particles with submicron dimensions in large amount and with close-to-bulk magnetic properties, which will be an enabling technology for the $3.9 billion magnetic MEMS (Microelectromechanical Systems) market. The applications include micro-sensors, -motors, -generators, -undulators, high frequency (THz) vacuum electronic devices etc. The permanent magnet nanoflakes can also be used in anisotropic bonded magnets, which have many industrial applications with a market size of $434 million per year worldwide.

Everspin Technologies

Phase II Award No.: 1058552

Award Amount: $499,347.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Structures for reduced critical current to enable Spin Torque Magnetoresistive Random Access Memory

This Small Business Innovation Research (SBIR) Phase II project aims to demonstrate a high-performance spin torque magnetoresistive random access memory (ST-MRAM). ST-MRAM technology promises a powerful combination of non-volatility, high density, high speed, and low power. The major impediment to commercializing ST-MRAM has been that the write current for programming the magnetic tunnel junction (MTJ) bits are too large. Large write current can cause tunnel barrier breakdown, thereby compromising memory reliability. Additionally, large write current requires large select transistors beneath each bit, preventing high density. In Phase I project, an MTJ bit design with a low enough write current has been successfully demonstrated. In this Phase II project, a large, high-density ST-MRAM demonstration circuit will be developed using this improved bit design. Several novel circuit design approaches that have potential for higher speed, higher density and lower power will be evaluated. The circuit will provide the bit statistics needed to optimize the bit design and enhance the yield to the level required for a highly reliable commercial ST-MRAM.

The broader/commercial impacts of this project will be the potential to enable the commercial applications of ST-MRAM. The Toggle MRAM is already finding many applications in the stand-alone memory market including networking, industrial controls, data server systems, military, aerospace industry etc. However, in order for MRAM to achieve its full commercial potential, higher density and lower power consumption are needed. High density translates to lower cost. Reducing power consumption is increasingly valued in areas such as portable electronics or even enterprise computing. ST-MRAM technology has the potential to meet these needs by combining non-volatility, high density, high speed, low power, unlimited endurance, and scalability in a single memory.

Free Form Fibers L.L.C.

Phase II Award No.: 1152698

Award Amount: $500,000.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Advanced Materials

SBIR Phase II: The Digital Spinneret

This Small Business Innovation Research (SBIR) Phase II project will build upon recent advances in nanotechnology and laser processing of materials to pursue the large-scale production of stoichiometrically pure silicon carbide (SiC) fibers which are very difficult to obtain by other means. The transition from laboratory scale to industrial production requires a sea change in manufacturing approach. The proposed research will investigate the parameters involved in creating a "Digital Spinneret" (DS), a novel technology platform which enables the production of large qualities of high-quality fibers. The Phase I project demonstrated feasibility of the Digital Spinneret to produce many fibers in parallel; the Phase II research will extend and optimize this manufacturing method.

The broader impact/commercial potential of this project will be the enabling of scaled production of high-purity ceramic fibers for application in military and aerospace (turbomachinery, rockets, advanced structures), automobile, medical, energy, and other industries that require advanced materials with exceptional strength, stiffness, heat resistance, and/or chemical resistance. These are fast-growing fiber markets with great potential, and with a collective size exceeding $1 billion. The projected energy footprint of this production method is 1/1000th that of competing methods, providing a huge cost advantage.

Fusion Coolant Systems, Inc.

Phase II Award No.: 1058288

Award Amount: $404,463.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Minimum Quantity Lubrication Delivered by Supercritical Carbon Dioxide for Forming Applications

This Small Business Innovation Research (SBIR) Phase II project aims to develop next-generation supercritical CO2 metalworking fluid (MWF) technology for highly demanding metal forming applications. The approach is to deliver specialized environmentally-friendly lubricants with supercritical CO2, achieving tool wear rates, forces, and surface finish at least as good as aqueous-based MWFs that are currently in use. It is anticipated that a much smaller amount of MWFs will be required with this technology. The formulation of new supercritical MWFs and the optimization of flowrates of oil and CO2 for metalworking processes will be studied. The patented supercritical CO2 system (so-called CHiP Lube) will be evaluated in real industrial settings to confirm its capability to replace current MWFs. The effectiveness and efficacy of CHiP Lube system will also be scaled and applied to other common industrial metal working processes such as rolling, extruding, and cutting.

The broader/commercial impacts of this project will be the potential to provide an environmentally-benign lubricant system as an alternative to conventional MWFs with equal or better performance and lower cost. At any given time, approximately 2 billion gallons of MWFs are in use in the U.S.A. This represents a massive waste stream that must be treated and remediated. Plus, the negative effects of MWFs on worker health and safety are well documented. The components of CHiP Lube are naturally occurring and used in extremely low quantities. Therefore, the waste treatment and worker health concerns are minimized. CHiP Lube has been demonstrated in simple metal removal applications as providing lower tool wear and/or higher machining speeds than conventional MWFs, thereby leading to a lower overall cost of manufacturing. In addition, no carbon dioxide will be produced to run the process, as the CO2 used in the process will be recovered from other industrial processes such as ammonia and ethanol production.

Heavystone Laboratory, LLC

Phase II Award No.: 1127286

Award Amount: $500,000.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Functionally Graded Cemented Tungsten Carbide -- Process and Properties

This Small Business Innovation Research (SBIR) Phase II project aims to develop an innovative process which can transform conventional cemented tungsten carbide (WC-Co), the most widely used industrial tool material, into functionally graded cemented tungsten carbide (FG WC-Co). Compared to the homogeneous structure of conventional WC-Co, FG WC-Co has a harder surface and tougher core due to a gradual increase of cobalt content from the surface to the core, which offers considerably higher wear resistance without sacrificing fracture toughness. This combination of mechanical properties leads to the superior engineering performance of FG WC-Co which translates to significantly improved tool life, reliability, and productivity.

The broader/commercial impacts of this project will be the potential to replace conventional WC-Co used in numerous manufacturing industries including auto and aerospace manufacturing, oil and gas drilling, geothermal energy exploration, mining, construction, and applications where extreme wear resistance is required. The replacement of conventional WC-Co tool materials with FG WC-Co is expected to lead to significant productivity improvements in these manufacturing industries. The annual addressable market is estimated to be over $5 billion.

Inlustra Technologies LLC

Phase II Award No.: 1058564

Award Amount: $423,988.00

Start Date: February 15, 2011
End Date: January 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Scalable Bulk GaN Crystal Growth

This Small Business Innovation Research (SBIR) Phase II project aims to grow gallium nitride (GaN) single crystals that are large enough to yield commercially-viable non-polar GaN substrates for optoelectronic devices. The feasibility of the crystal growth processes was demonstrated in Phase I. This Phase II project will focus on the reproducibility and scalability of the crystal growth and back-end processing methods. It is anticipated that the resulting per-unit price reduction will accelerate the adoption of GaN substrates by ultra-high brightness light emitting diode (LED) manufacturers.

The broader/commercial impacts of this project will be the potential to provide large-area non-polar GaN substrates for applications in advanced GaN-based light emitters such as laser diodes and ultra-high brightness LEDs. GaN-based LEDs present exciting long-term prospects for solid-state lighting, via the replacement of inefficient and/or toxic conventional light sources such as light bulbs and fluorescent lamps. However, the LEDs must be sufficiently low cost and demonstrate high luminous output power to justify the replacement of existing conventional lamps. GaN-based LEDs fabricated on non-polar GaN substrates that will be developed in this project has the potential to meet the most demanding lighting requirements, whereas conventional polar GaN-based LEDs ultimately cannot.

Innova Dynamics, Inc.

Phase II Award No.: 1152722

Award Amount: $499,171.00

Start Date: May 1, 2012
End Date: April 30, 2014

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Sector: Advanced Materials

SBIR Phase II: Efficient Manufacturing of Nanostructured Flexible Transparent Conducting Electrodes

This Small Business Innovation Research (SBIR) Phase II project aims to develop high-performance transparent conductors as a replacement to Indium Tin Oxide (ITO) in touchscreens. ITO suffers from a number of disadvantages, including being one of the most expensive components of a touchscreen device, complex manufacture, and inflexibility. In this project, a transparent conductor will be developed using solution-based conventional coating equipment. Two key features of this novel transparent conductor are: (1) ease of processing, which eliminates many conventional processing steps involved in coatings; and (2) extreme durability, which enables the creation of next-generation touch devices that are otherwise impossible to realize with ITO or other ITO-alternative materials. The tradeoff between photonic transmission and electronic conduction will be theoretically and experimentally studied by extracting effective optical parameters of transparent conductor films. The printed touchscreen sensors will be integrated into functional multi-touch projected-capacitive devices, which are expected to show mechanical flexibility, higher signal to noise ratios, and faster response times.

The broader/commercial impacts of this project will be the potential to enable enhanced performance of touchscreens at disruptively lower costs. The total addressable market of patterned transparent conductor materials for touchscreen industry is about $1.3 billion today. Currently, material and processing costs of ITO represent a growing portion of the bill of materials for touchscreen devices. Transparent conductors to be developed through this project offer low-cost, high-performance, and high production throughput benefits, which will address the ITO-related challenges in touchscreen industry. Other applications of this technology includes liquid crystal displays, organic light emitting diodes, e-paper, flexible displays, thin film photovoltaics, electromagnetic shielding, defrosting windshields, low-emissivity architectural glass, and smart windows.

Integrated Surface Technologies

Phase II Award No.: 1026571

Award Amount: $508,000.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Durable Super-Hydrophobic Nano-Composites

This Small Business Innovation Research (SBIR) Phase II project seeks to further develop and commercialize a new class of durable, water-resistant nanocomposite coatings identified and explored during the Phase I project. The unique processing conditions used to make these nanocomposite coatings produce a virtually invisible, conformal, nanometer-scale film that is comprised of surface bound nanoparticles and offers superior water barrier properties while still permitting through-film electrical connections. The newly developed coating has the potential for great commercial impact and can be thought of as a "game changer" for certain consumer electronic markets. The innovation and research plan for Phase II centers on two critical issues for commercial integration: 1) the overall processing efficiency of the material and 2) issues of long-term reliability and chemical interaction with existing platforms.

The broader impact/commercial potential of this project will be felt in a number of consumer, military, and medical products. It is estimated that about 1.2 billion mobile handsets are produced annually and that 8% of all the damages that occur to handsets are from liquid ingress. If fully adopted by the industry, this coating could reduce the liquid ingress damage to nearly zero, resulting in significant savings to consumers. Additionally, medical hearing aids would benefit from the oleophobic protection provided by this material, and its use would result in a decrease in the number of units returned annually for corrosion, water damage and ear wax contamination (this number currently stands at 11 million). Finally, the integration of our protective coating into other existing electronics products will add significant value to these products and will make them more durable and attractive to consumers globally.

Kent Optronics, Inc.

Phase II Award No.: 1058571

Award Amount: $441,558.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Ultrafast Self-Reactive Laser Eye Protection Devices

This Small Business Innovation Research (SBIR) Phase II project will develop ultra-fast laser eye protection (LEP) devices from nano-composite materials. Commercial LEP eyewear can only protect against a limited number of known laser wavelengths, with users having to change eyewear for different lasers. The new LEP eyewear will be a universal solution to protect human eyes against both known and unknown lasers in the visible and infrared (IR) spectral range, promising >60% visual luminous transmittance, >4 optical density, femtosecond response time, and full compliance with industrial and military standards. The LEP eyewear is expected to have adequate optical limiting threshold so that it does not require an extra focusing lens array for assistance. The material to be developed is semi-solid and can be integrated with ballistic-proof polycarbonate (PC) substrates, and requires no electrical power. This project will also be applicable to products for laser protection of optical sensors. The Phase II research activities involve material and manufacturing process optimizations as well as environment durability tests.

The broader impact/commercial potential of this project is significant. It will meet the critical unmet customer demand for a universal laser eye protection device, which is key in many military and industrial fields. The LEP products will create cost savings for customers (by providing a universal solution), reduce eye injury risk, and allow ballistic and shatter-proof capability. These devices have the potential to address the entire laser eye protection market, and cumulative LEP eyewear sales for the first five years are projected to exceed $10 million. This program will also advance the state-of-the-art in science and engineering, in developing novel nanostructures from phase-transitioning materials, as well as a new device structure with superior optical characteristics. Finally, this project will have societal benefit by helping to reduce the medical, insurance and associated costs of laser eye injuries.

LC Vision, LLC

Phase II Award No.: 1058604

Award Amount: $500,000.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Ion and Radical-Free, Polymer-Stabilized, Vertically-Aligned Nematic LCDs for Enhanced Lifetime

This Small Business Innovation Research (SBIR) Phase II project will develop a new type of process to improve the quality and reduce the cost of large liquid crystal displays (LCDs), particularly those used for energy efficient high-definition televisions. Rather than the existing approaches that synthesize a polymer inside the display, this research examines polymers synthesized and purified outside of the display. Side-group liquid crystal polymers (SGLCPs) will be developed that can be used at low concentration as dopants in the liquid crystal mixture that is the active medium in the LCD. Chemical variations on the successful SGLCPs discovered in Phase I will establish molecular-level understanding of the mechanism of the beneficial effects of the dopant. Effects of the dopants on processing behavior (e.g., the process of filling the flat panel) and ultimate performance will be characterized; the results will guide industrial implementation of the dopants.

The broader impact/commercial potential of this project on new polymer dopants include improved performance of LCD-TVs, especially in the rapidly growing HDTV segment. Liquid crystal displays are widely used in televisions due to their low operating voltage, low power consumption and thin form factor. Polymer additives will be developed that increase the switching speed, enhance the brightness, improve the viewing angle and maintain the excellent dark state and high contrast that are the hallmarks of vertically-aligned nematic liquid crystal displays (VAN-LCDs). The potential revenues of these compounds could reach $100 million annually within a few years. Scientifically, polymer dopants in LCs represent an entirely new field of science and technology. Finally, this collaborative research will involve a combination of microsynthesis, polymer and LC physical properties and LC display fabrication that will confer upon its principals a comprehensive perspective on the transition of discoveries into competitive product offerings.

Lono LLC

Phase II Award No.: 1152252

Award Amount: $499,591.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Advanced Materials

SBIR Phase II: Thin Film Patterned Optical Retarders for Low Energy Smart Glass Applications

This Small Business Innovation Research (SBIR)Phase II project will develop a low-cost smart-window technology. This project will utilize contemporary display industry fabrication and processing technologies to create unique large-area optical films. These films will be subsequently used to construct energy-efficient smart windows that modulate transmission or reflection of light on command. Windows, skylights, and other glazings made with this technology will have the ability to darken on command. In this Phase II project, window-size prototypes will be designed, constructed and evaluated. Production, material costs, and prototype operation will be considered. Successful fabrication of these prototypes will enable smart windows to be manufactured in an electrochemically passive manner, simplifying their installation in existing windows, minimizing up-front costs, and ultimately reducing energy bills. The technology is also uniquely capable of being applied as an aftermarket or retrofit solution.

The broader impact of this project will be a potential savings of billions of dollars in energy costs in the United States alone, and a reduction of carbon footprint. Buildings are responsible for seventy percent of the electricity consumed in the United States. As part of a daylighting /natural heating strategy, smart window technologies have received much attention for their ability to reduce building energy consumption. Unfortunately, existing smart window products suffer from severe limitations in lifespan, scalability and cost. The technology to be developed is a radically different approach to smart windows because instead of electrochemical processes, it utilizes stable films. This affords more chemical stability, longer life, better manufacturing scalability, power independence (via manual operation), and lower costs to the consumer.

Nanotek Instruments, Inc.

Phase II Award No.: 1127394

Award Amount: $463,406.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Prakash Balan

Sector: Advanced Materials

SBIR Phase II: Ultra High Capacity and High Rate Anodes for Next Generation Lithium-Ion Batteries

This Small Business Innovation Research (SBIR) Phase II project aims to develop cost-effective and commercializable anode materials exhibiting large lithium storage capacity, high rate capability, and long cycle life for next generation lithium-ion batteries. Silicon-based anode materials hold great potential to meet the high energy density requirements for advanced lithium ion batteries. However, the intrinsic low electrical conductivity and huge volume change of silicon during lithium insertion and extraction lead to quick electrode failure, and thus hindering their practical applications. The proposed Si nanocomposites are expected to effectively prevent the crumbling of Si particles, maintain the integrity of the electron-conducting network, and allow the electrolyte solution to easily access the active sites. This phase II project will develop and optimize the nanocomposite compositions and related synthesis and processing procedure to accelerate industrial scale manufacturing of anode materials in the US.

The broader impact/commercial potential of this project is the development of a new anode technology capable of exploiting a dramatic improvement in lithium ion battery performance, which will speed the deployment of advanced lithium ion batteries for plug-in hybrid electric vehicles and all electric vehicles.

NCD Technologies, LLC

Phase II Award No.: 1127516

Award Amount: $500,000.00

Start Date: September 1, 2011
End Date: August 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Improving the Adhesion of Nanocarystalline Diamond Films to Tungsten Carbide Micro End Mills

This Small Business Innovation Research (SBIR) Phase II project aims to develop a novel, commercially-viable, hybrid system that improves the adhesion of nanocrsytalline diamond (NCD) coatings to tungsten carbide (WC) cutting tools. A new hybrid system will be assembled, tested, and optimized. Research will be conducted to scale up the process to reach the capability of coating more than 3,000 cutting tools at one time. Further research will be conducted through laboratory and industrial machinability testing on these diamond-coated micro end mills. Testing variables include tool size, tool geometry, machining parameters (cutting speed, axial depth of cut, feedrate), workpiece material and environmental conditions. Industrial feedback will be used to ensure coating optimization to meet the needs of real users.

The broader/commercial impacts of this project will be the potential to significantly improve the performance of micro tools. An important area of this industry is currently limited by poor micro end mill performance. Improved tooling performance will not only reduce the capital machine cost in this field, but also help realize the miniaturization of existing cutting-edge technology limited by current manufacturing capabilities. The most promising societal benefits of NCD tool coating will be realized in healthcare industry as diamond coatings are essential for the development of next generation biosensors and biomedical devices. This will significantly improve the quality and substantially reduce costs associated with biological sample testing, reducing the financial burden of healthcare expenses on individuals and the country.

NuForm Materials, LLC

Phase II Award No.: 0923822
Phase IIB Award No.: 1216295

Award Amount: $761,251.00

Start Date: July 15, 2009
End Date: December 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Improved Manufacturing Methodology for Aluminum Ash Metal Matrix Composite Materials

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research(SBIR)Phase II project seeks to overcome the principal impediments of the inconsistent quality of metal matrix composite (MMC) materials from fly ash and aluminum. This project utilizes highly processed ash derived ceramics (ADC) as a reinforcing phase in aluminum MMCs manufactured with powder metallurgy (P/M) methods. The processed ADC has a narrow size distribution and is free of carbon, magnetite, and cenospheres. In powder metal technology the ADC alters the strength, stiffness, and hardness of the aluminum. When blended with aluminum powders and compacted into parts, aluminum MMC materials can be fabricated with stiffness properties like ductile iron. Sintering parameters can be manipulated to control the aluminum-ADC reaction and the silicon metal and spinel that it generates, thus creating wear resistance and hardness. The MMC then behaves like a hypereutectic alloy. The primary objective of this project is to formulate one or more high performance ADC-aluminum MMCs that are ready for commercial deployment. Achieving this level of performance will allow ADC-aluminum MMCs to compete directly with hypereutectic alloys and ductile iron in the production of parts for the transportation industry.

The broader impact/commercial potential of this project will be the ability to derive high quality, ash derived ceramics (ADC) that are recovered from coal combustion ash for use in new light weight high strength composite materials. These materials are needed in the transportation industry where weight, cost, and performance are critical. ADC-aluminum metal matrix composites can be used to manufacture parts for the transportation industry such as brake rotors, and drive train components that are currently made from ductile iron or hypereutectic alloys, materials that are heavier and/or difficult to machine. This material change will decrease the overall weight of the vehicle, thereby improving its fuel efficiency and performance while improving the margins for parts manufacturers. This technology will create a new commodity that will lead to the creation of new jobs and help support the needs of the automotive and transportation industries.

Orthogonal, Inc

Phase II Award No.: 1058509

Award Amount: $483,701.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Enabling Large-Scale Manufacturing of Organic Electronic Devices Using Photolithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a photoresist system that is compatible with a much wider range of materials than traditional photoresists, allowing for the patterning of advanced semiconducting polymers and small molecules on existing photolithographic equipment. Through Phase I project, Orthogonal has improved its fluorinated photoresist system by making two new materials with lower manufacturing cost and enhanced performance. In this Phase II project, the patterning of the widely used conductive polymer poly (3,4-ethylene dioxythiophene): poly(styrene sulfonic acid) (PEDOT:PSS) and similar acidic materials will be studied. Multiple approaches will be taken to continuously improve the performance of the new photoresist materials. The scalability of one or both photoresist materials to large quantities will be investigated by addressing the major issues that may be challenging to the scale-up, including dealing with heat generation and finding a suitable initiator.

The broader/commercial impacts of this project will be the potential to enable the large-scale manufacturing of organic electronic devices by leveraging the existing photolithographic infrastructure currently used in the industry. The availability of the new photoresist materials in large quantities and consistent quality will help meet the performance and volume demands of organic electronic industry, which is expected to grow rapidly once a scalable and high-yield manufacturing technique is available.

Oscilla Power, Inc.

Phase II Award No.: 1127503

Award Amount: $488,271.00

Start Date: August 15, 2011
End Date: July 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Materials for Renewable Energy Systems

This Small Business Innovation Research (SBIR) Phase II project will demonstrate a prototype wave energy harvester using advanced materials developed in the Phase I effort. We have developed a patented concept for wave energy harvesting using low-cost magnetostrictive alloys. This technology shows promise as a means for delivering utility-scale electric power to the grid at a price that is competitive with conventional fossil or renewable technologies. The technology will also be applicable to other proprietary energy harvesting systems that we are developing. In the Phase II project, we will design, build, optimize and demonstrate a sub-scale system in one of the largest open-air salt water wave tanks in the world. After prototype validation in Phase II, we will pursue further scale up and commercialization of the device with additional private/ government funding.

The broader impact and commercial potential of this project address the global need for the rapid development and deployment of low-carbon, renewable electricity sources, which unquestionably ranks as one of this century's global grand challenges. Such technologies will fuel our economic growth, contribute to global environmental sustainability, and reduce our dependence on polluting and exhaustible fossil fuels such as coal and natural gas. The world's oceans, with global capacity estimated to be around 2 TW, constitute a vast but untapped energy source that is particularly well-suited to address underserved and/or growing coastal populations. The World Energy Council estimates that wave energy can meet up to 6.5% of U.S. energy needs. Efforts to tap utility-scale energy from the ocean continue to be hampered by high capital costs, high maintenance costs, and low energy efficiencies. The technology developed through this project will accelerate the commercialization of a wave energy harvester with substantially lower capital and operating costs than existing alternatives, enabling a levelized cost of electricity that is competitive with conventional electric power technologies.

Pipe Wrap LLC

Phase II Award No.: 1152577

Award Amount: $500,000.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: Advanced Materials

SBIR Phase II: A High Strength and Durable Composite NanoWrap for Repair and Rehabilitation of Piping and Other Civil Infrastructure Systems

This Small Business Innovation Research (SBIR) Phase II project will continue the development, validation, and full-scale testing of a new patent-pending nanoparticle-reinforced composite product for the repair and rehabilitation of piping and other civil infrastructure systems. The overarching goal of the research is to develop and demonstrate a composite system that can be used to repair pipes without requiring expensive, and sometimes dangerous, cutout and repair of pipe sections, while also meeting Department of Transportation (DOT) requirements to qualify it as a permanent rather than temporary repair. In order to meet these requirements, a composite wrap system is needed with fatigue properties that are much better than current systems. Test results obtained in Phase I demonstrate that the fatigue resistance of our new nanoparticle-reinforced composite repair system outperforms traditional pipeline repair composite materials currently on the market. The specific goals of Phase II will be: 1) validation of initial results from Phase I; 2) extension of property testing to prepare for full-scale testing under American Society of Mechanical Engineers (ASME) PCC-2 requirements; 3) design of a manufacturing machine to produce the new composite product and 4) completion of full-scale testing to prove compliance with DOT regulations.

The broader impact/commercial potential of this project will be to significantly improve the safety and reduce costs for repair of DOT-regulated and industrial pipelines through the development of a high-strength, fatigue- and corrosion-resistant pipe repair system with a design life over 50 years. There were 6,042 "significant incidents" related to pipeline damage from 1988 to 2008, resulting in 427 fatalities, 1,805 injuries and property damage totaling $3.8 billion. Composite repair products currently used to prevent pipeline failures are economical, easy to apply, and can be used to repair other civil infrastructures such as bridge columns and piers. However, current composite repair systems for pipelines qualify only as a temporary repair due to their susceptibility to fatigue, and therefore require eventual replacement via cut-out. Development of a composite wrap system that qualifies as a permanent repair would have a transformational impact on the pipeline industry, placing the commercial potential of this product at $50-100 million, even with a relatively small market share. In addition, with the availability of stronger and less expensive field repairs, pipeline companies are likely to become more proactive with their composite repair programs, resulting in an overall reduction in catastrophic failures and incidents.

PolarOnyx, Inc.

Phase II Award No.: 0952237
Phase IIB Award No.: 1237951

Award Amount: $749,569.00

Start Date: April 1, 2010
End Date: June 30, 2013

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Sector: Advanced Materials

SBIR Phase II: A MHz High Energy Femtosecond Fiber Laser System for High Throughput Photonic Device Fabrication

This Small Business Innovation Research Phase II project will develop an integrated femtosecond high-energy fiber source for high-throughput photonics device fabrication. The final goal of the project will be a laser oscillator/amplifier that confines the pulse to the fiber throughout the generation and amplification process. This will lead to high stability, robustness, and easy integration into other systems. These characteristics will make the fiber laser system superior in terms of production throughput, size, and cost. Phase II will develop a functional prototype of the fiber laser. To demonstrate the ability of the laser to fabricate real-world devices, experiments will be carried out involving the microfabrication of glass and waveguide channels.

The broader impact/commercial potential of this project will be a breakthrough in understanding of high-energy femtosecond fiber lasers and an unprecedented new design for laser products across a wide range of applications. The new laser product will offer a combination of high power, high repetition rate, and low cost which surpasses any existing laser on the market today. Potential markets include photonic device fabrication (e.g. for waveguides, couplers, modulators, and switches), metal processing (welding, cutting, annealing, and drilling), semiconductor and microelectronics manufacturing, general materials processing (e.g. rapid prototyping, desktop manufacturing, micromachining, and photofinishing), medical equipment, and biomedical instrumentation. In the medical area, potential applications include ophthalmology, refractive and general surgery, photocoagulation, therapeutics, imaging, and cosmetic applications. Biomedical measurements which might be affected include cytometry, DNA sequencing, laser Raman spectroscopy, spectrofluorimetry, ablation, and laser based microscopes.

Porifera inc.

Phase II Award No.: 1058572

Award Amount: $515,710.00

Start Date: April 1, 2011
End Date: March 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Ultra Permeable Carbon Nanotube Membranes for Forward Osmosis

This Small Business Innovation Research (SBIR) Phase II project will take advantage of the unique properties of carbon-nanotube (CNT) pores to develop membranes that are specifically tailored for forward osmosis (FO) applications. FO processes have a number of advantages over evaporation and pressure-driven membrane processes: low energy cost, low mechanical stresses, and high product concentration. The main problem impeding the widespread use of FO remains the lack of robust optimized FO membranes. CNT membranes are ideal for FO applications as they offer improvements in all relevant membrane characteristics: (1) improved structural integrity; (2) high permeability; (3) robust chemical stability; and (4) low fouling propensity. Most importantly, CNT membranes can be fabricated with sufficient structural support in the active layer to operate with only minimal external reinforcement, which minimizes concentration polarization losses. This project builds on the fabrication and functionalization approaches developed in Phase I, and applies them on a larger scale to achieve the objective of developing membranes with fast flow and high selectivity at reasonable production costs. Performance of the membranes will be benchmarked using laboratory tests that simulate real-world applications. This project will deliver an innovative FO membrane platform that exhibits superior performance and stability in FO applications.

The broader impact/commercial potential of this project will be to enable a variety of green technologies such as renewable power generation, wastewater reuse, and energy-efficient desalination. Although FO-based processes are extremely energy efficient, their commercial use has been hampered by the lack of high performance FO membranes. This project should produce two main outcomes. First, it would deliver a solid technical foundation for developing a novel FO membrane platform that would provide a superior commercial alternative to existing FO membrane architectures. Second, the performance advantages of the CNT membranes would open up several applications for commercial development.

Refactored Materials

Phase II Award No.: 1151896

Award Amount: $500,000.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Commercial Scale Production of Synthetic Spider Silk Fibers

This Small Business Innovation Research (SBIR) Phase II project will continue the development and commercialization of spider silk fibers commenced in the Phase I effort. Spider silk is a unique material in nature that is currently inaccessible on a commercial scale. Spider silk and other protein polymers are broadly useful in fields ranging from specialty textiles, to medical devices and advanced composites. The critical limitation in producing artificial spider silk fibers has been the lack of availability of bulk silk material and the knowledge of how to appropriately process the polymer into a product of native quality. This project will continue prior work to deliver scalable quantities of material through microbial production of spider silk protein using a commercially viable cost structure. In addition, this project will examine the key parameters for processing silk polymer into fibers whose properties surpass those of native spider silk. The ability to produce prototype silk fibers from recombinant protein will enable the initial steps towards commercializing spider silk fiber-based products.

The broader impact/commercial potential of this project is important to the adoption of a job-creating bio-based economy in the United States. The ability to produce protein polymers has bedeviled biological researchers for decades. Many important structural proteins and enticing commercially-useful materials have remained effectively impossible to produce. The advent of cutting-edge techniques in synthetic biology, microfabrication, and materials processing now make the production of protein polymers and the processing of them into beneficial technologies a realistic goal. Potential applications of protein-based polymers include a full range of sophisticated materials that are furthermore "green" and sustainable. Spider silk polymers, due to their mechanical properties, can potentially be used to create the next generation of ballistic fibers in the production of armor for military, law enforcement, and private users. In addition, the ability to produce advanced polymers independent of petroleum sources is a key goal of the emerging bio-based economy. Lastly, many protein polymers (including silk) are biocompatible and biodegradable and thus can form the basis for new classes of medical materials used to replace or re-grow connective tissues with implants or devices.

Romny Scientific, Inc.

Phase II Award No.: 0848530
Phase IIB Award No.: 1123386

Award Amount: $1,014,926.00

Start Date: March 1, 2009
End Date: May 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Thermo-Electric Conversion by Optimally Scaled Nanocomposite Materials

This Small Business Innovation Research Phase II project will develop a power generation device capable of converting waste heat into electricity with much lower cost/watt than existing devices. This work is accomplished by bringing together principles of physics and materials science in practical wafer scale semiconductor manufacturing, enabling new, low cost products.

The thermoelectric power generation devices to be developed in this work are key to realizing the often touted but yet unrealized societal benefits of thermoelectric power generation. Examples of benefits that can be forseen in the initial target market, the transportation industry, are economic benefits for the public from reduced fuel consumption and reduced environmental impact due to more efficient operation.

SC Solutions Inc.

Phase II Award No.: 0923830
Phase IIB Award No.: 1216892

Award Amount: $830,033.00

Start Date: August 15, 2009
End Date: April 30, 2013

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Sector: Advanced Materials

SBIR Phase II: Model-Based Control for Chemical-Mechanical Planarization of Copper/low-k Films

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project will develop a commercial prototype of a real-time model-based controller software for next-generation Chemical-Mechanical Planarization(CMP) systems used in semiconductor wafer manufacturing. Planarization is an enabling step for semiconductor interconnects that is critical to the industry's keeping up with Moore's law. Future technology nodes of 32 nm and below require improved level of performance in planarization technology. Smaller dimensions and the use of more delicate low-k films pose increasingly stringent requirements on planarization performance.

The successful development of the proposed controller software will help extend planarization to new levels of performance for 32 nm technology and beyond. The copper planarization market is anticipated to reach $824 million in 2009, and a next-generation CMP controller product will have a significant impact on the future of this market. The proposed innovations will help to accelerate the adoption of new dielectric structures in next-generation semiconductor devices.

SOLARNO

Phase II Award No.: 1127564

Award Amount: $499,953.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Prakash Balan

Sector: Advanced Materials

STTR Phase II: High Energy and Power Density Supercapacitors Utilizing Electrodes Comprising Nanofibrous Carbon-Carbon Composites

This Small Business Technology Transfer (STTR) Phase II project will optimize the technology developed in Phase I for the fabrication of composite carbon nanofibers incorporating mesoporous high surface area carbon as an electrode material for supercapacitors utilizing ionic liquid electrolytes. The Phase I results showed that test devices incorporating our patent-pending carbon fibers have surpassed the performance of commercial supercapacitors and can provide energy densities approaching that of lead acid batteries with superior gravimetric power density. The technology is to be further developed and optimized using lower cost polymer precursors and carbon templates. Achievement of our Phase II goals of 30 Wh/kg at 10 kW/kg (packaged) with consistent performance up to 5x10^5 cycles means that this technology can become the material of choice for application to high-energy, high-power energy storage systems.

The broader impact/commercial potential of this project lies in greatly expanding the market for supercapacitors for existing products and enabling new technologies, especially in those areas requiring energy densities that are higher than those provided by current supercapacitors. Such supercapacitors will be well suited for application to the Hybrid Electric Vehicle (HEV) market, including rapid charging stations; frequency regulation for the electric grid; and load leveling for renewable energy sources. Direct societal benefits will come from improving the viability of HEV due to reductions in fossil fuel consumption, improvements in power grid reliability, reducing costs for renewable energy production, and in replacing lead acid batteries. The world demand for supercapacitors is expected to reach $1.2 billion by 2015.

SolRayo, Inc.

Phase II Award No.: 1156229

Award Amount: $499,998.00

Start Date: April 1, 2012
End Date: March 30, 2014

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Program Director: Ben Schrag

Sector: Advanced Materials

STTR Phase II: Using Nanoparticle Oxide Coatings to Extend Cycle Life of Cathode Materials in Lithium-Ion Batteries

This Small Business Innovation Research (SBIR) Phase II project seeks to increase the cycle life of cathode materials used in lithium-ion batteries by a factor of ten in high-temperature applications by applying protective nanoporous ceramic coatings. SolRayo will investigate the effects that changing several variables that control the nanoporous structure of ceramic coatings have on the cycle life of cathode materials. Such variables include the amount or thickness of the coating, the pH of the suspension of the coating material, the deposition of layers of different ceramic materials on the cathodes, and different methods for depositing the coatings on the cathodes. The materials to be investigated will include TiO_2, ZrO_2 and others proposed by our industrial partner.

The broader impacts of this research are that, if successful, this project will improve the cycle life of lithium-ion batteries and allow inherently safer and less expensive materials to be employed. Although lithium-ion batteries have gained wide acceptance in consumer electronic products, their use in other markets has been limited by their lifetimes and safety concerns, particularly in applications at higher temperatures. Improving the lifetime and safety of the materials used in these batteries will enhance their market penetration. Preliminary cost estimates indicate that licensing the coated materials to industry could provide approximately $100 million annually in royalties on sales. This work will also benefit the nation by improving our understanding of nanoparticle coating techniques suitable for a variety of energy storage applications.

Soraa, Inc., aka SJS Technologies

Phase II Award No.: 1026896

Award Amount: $515,999.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Sector: Advanced Materials

SBIR Phase II: High quality, low cost bulk gallium nitride substrates

This Small Business Innovation Research (SBIR) Phase II project aims to develop a scalable, compact and rapid ammonothermal method to grow high-quality, low-cost bulk gallium nitride (GaN) substrates. A novel apparatus that is scalable to large volumes at modest cost will be utilized to achieve high-pressure, high-temperature conditions and grow single-crystal GaN. This project is expected to demonstrate the synthesis of ultrapure raw material and the growth of high-quality bulk GaN crystals with excellent crystallinity, improved transparency, a diameter of at least 1 inch and a process capable of rapid scale-up to larger sizes.

The broader/commercial impact of this project will be the potential to offer high-quality and significantly lower cost GaN substrates, which may enable their applications in next generation displays including light-emitting diodes (LEDs), green and blue laser diodes etc. Bulk GaN substrates, currently in use for 405 nm laser diodes only and grown by a vapor-phase technique, are projected to be a $405 million market in 2010. The availability of low-cost and high-quality bulk GaN substrates is anticipated to improve efficiency and reduce cost of GaN-based LEDs, which will enable a large reduction in electrical power consumption.

Sun Innovations, Inc.

Phase II Award No.: 0848519
Phase IIB Award No.: 1205505

Award Amount: $839,801.00

Start Date: March 15, 2009
End Date: August 31, 2012

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Advanced Nano-Phosphors for Novel Electronic Displays

This Small Business Innovation Research (SBIR) Phase II project is to develop a fully functional color "transparent display screen" prototype, based on a set of outdoor stable nano-phosphors with very high fluorescent quantum efficiency and well-controlled nano-particle sizes. With these advanced nano-phosphors, a color display windshield prototype will be developed.

This novel "transparent display screen" technology will enable an entire vehicle windshield or building glass windows to act as an electronic display screen, without affecting the optical clarity. This innovative display technology will leverage and create a broad spectrum of commercial applications and fundamentally change the way that people use "glass" in many designs.

TechDrive, Inc.

Phase II Award No.: 1025712

Award Amount: $481,978.00

Start Date: September 1, 2010
End Date: August 31, 2012

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Program Director: Prakash Balan

Sector: Advanced Materials

SBIR Phase II: Low Cost, High Performance Electrolytes for Lithium-ion Batteries

This Small Business Innovation Research (SBIR) Phase II project is poised to introduce superior electrolytes to the lithium-ion batteries by using a new class of low-cost, high-performance lithium salts. Currently, the cost of batteries is impacted not only by the high cost of the lithium salts, but also their relatively lower stability that limits battery lifetime. If successful, these electrolytes, to be developed under this Phase II project, will possess higher ionic conductivity and superior thermal and electrochemical properties that will be very attractive particularly for full size lithium-ion batteries applicable to electric vehicles and hybrid electric vehicles (EV/HEV). Building on the company's earlier success in developing a novel two-step synthetic strategy to prepare these salts which contain two lithium ions versus one in currently used salts, this project will optimize and scale up the synthetic process leading to the production of these salts at much lower cost, while meeting all principal specifications, including high transference number, an attractive property of a battery to function properly at subzero temperatures. This project will also further explore synthetic approaches to deliver even lower cost to capture the small size lithium battery market, where the applications are in computers, cell phones, cameras, and medical devices.

The broader/commercial impact of this project will be in the area of the rechargeable battery industry, especially in the arena of EV/HEV. Cost, performance and battery life are major drivers of this industry. The availability of electrolytes of lower cost, high performance and enhanced stability will contribute to cost reduction needed to make battery driven applications more affordable to users. The successful outcomes of this project are expected to contribute to the US Government's emphasis on renewable energy and particularly, the Department of Energy's roadmap on advanced batteries with more robust and stable chemistries and cost effectiveness.

Transparent Materials, LLC

Phase II Award No.: 1057826

Award Amount: $467,551.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Innovations in Nanoscale Manufacturing: Nanomaterial Composites for Dental Restorations

This Small Business Innovation Research (SBIR) Phase II project seeks to develop nanomanufacturing methods for producing nanocomposites for use in dentistry. Nanocomposites have shown great promise in dentistry but have limited applications because of the lack of reliable manufacturing methods to prepare them at scale. This Phase II project seeks to develop a new, highly-efficient and low-cost approach to the manufacture of these materials that allows their assembly from the individual components at the nanoscale. The process produces highly homogeneous nanomaterials with increased functionality. These materials simultaneously have multiple property enhancements such as radiopacity (aiding diagnostic capabilities), high strength and durability, and improved optical properties. This technology can be further leveraged to expand market opportunities into adjacent segments where cost constraints have limited the adoption of advanced nanocomposites.

The broader impact/commercial potential of this project is to provide nanomaterial composites that improve the function of dental restorations and of biomedical implants. The technology is anticipated to facilitate medical implant materials that better integrate into the human body, improve durability and use-life, and aid diagnosis, ultimately reducing the rate of revision procedures and improving patient outcomes. In the context of dental restoratives, these materials offer improved aesthetics, enhanced radiopacity for diagnostics, and state-of-the art strength and durability. The development and maturation of the proposed products will have significant impact upon the dental industry, allowing dentists to better diagnose recurrent caries, which will improve clinical outcomes and ultimately reduce the occurrence of clinical revision/replacement procedures. The cost savings associated with the new process will increase access of the general public to the highest quality dental restorations.

Vorbeck Materials Corp

Phase II Award No.: 1152700

Award Amount: $497,243.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Ben Schrag

Sector: Advanced Materials

SBIR Phase II: Graphene Conductive Inks for Flexible Printed Electronics

This Small Business Innovation Research (SBIR) Phase II project aims to develop high-performance graphene-based conductive inks for printed electronics to meet its stringent cost, flexibility, and conductivity requirements. Components printed with existing conductive inks are challenged by repeated flexing cycles that can break conductive paths. In this project, a graphene filler technology and a novel formulation will be used to achieve the combination of electrical, mechanical, and environmental durability properties specified for the flexible printed electronics at a price point that enables high-volume applications.

The broader/commercial impact of this project will be the availability of a conductive ink that meets performance requirements of next-generation printed electronics. The printed electronics market is growing across multiple sectors driven by applications including radio-frequency identification (RFID) tags for tracking inventory, smart packaging for anti-theft and anti-tampering purposes, smart cards and printed displays. Conductive inks are a critical component in printed electronics, and limitations of existing conductive inks have curtailed market growth. The new graphene-based conductive inks are expected to demonstrate flexibility and mechanical robustness that improves lifetime and performance of printed electronics, while providing significant cost advantage over silver-based inks currently widely used in printed electronics industry.

Whole Tree, Inc.

Phase II Award No.: 1026842

Award Amount: $500,000.00

Start Date: August 1, 2010
End Date: July 31, 2012

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Sector: Advanced Materials

SBIR Phase II: Coconut (Coir) Fiber Automotive Composites

This Small Business Innovation Research (SBIR) Phase II project will resolve the technical issues associated with scaling up the manufacturing of non-woven fabric composites made from a blend of coir fiber (from coconut husks) and recycled polypropylene. Final product variability due to the coir fiber itself, the milling of coir fiber from coconut husks, and the manufacturing process to make the felted composite, will be minimized. The variability of the coir fiber feedstock will be determined, along with the resulting variation of the composite's flexural stiffness. The most cost-effective production process to produce consistently clean, 2-3" long fibers in-country from husks will be defined. Finally, the manufacturing processes required to produce these coir fiber composites with the required consistency for automotive applications will be developed. This project will include continuous input from a major automotive manufacturer as well as an automotive parts maker. This research will result in an improved readiness of a polypropylene/coconut fiber based non-woven fabric composite that meets industry certifications for use in automobile trunk liners, and which is greener, less expensive, and better performing than current all-synthetic parts.

The broader/commercial impact of this project will take many forms. The total market for automotive non-woven fabric composites is 300 million kg/year. Each vehicle platform that adopts this technology will require 2 million kg/year just for the trunk liners. Replacing synthetic fiber with coconut fiber makes parts more environmentally friendly while utilizing a waste material. Petroleum consumption can be reduced 2-4 million barrels per year and CO2 emissions reduced by 450,000 tons per year by replacing polyester fibers with coir in automotive interior composites. Additionally, the improved performance and lower weight of these materials will lead to cost savings through increased fuel economy, saving up to 3 million gallons of gasoline per year in the U.S. Finally, this project will lead to great economic opportunities for poor coconut farmers and to a very positive environmental impact. Ninety-five percent of the 50 billion coconuts grown worldwide are owned by 10 million coconut farmers whose average income is less than $2/day. Approximately 85% of the coconut husks are currently disposed of as trash, creating pollution. The successful adoption of these materials would create a market for this material, in many cases doubling the annual income for these farmers.

Zwitter Technology, LLC

Phase II Award No.: 1127475

Award Amount: $441,415.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Advanced Materials

SBIR Phase II: Commercialization and Scale Up of Ultra Low Fouling and Functionalizable Surface Coatings Based on Zwitterionic Polycarboxybetaine

This Small Business Innovation Research (SBIR) Phase II project aims to demonstrate the extraordinary performance of zwitterionic technology in protein interaction analysis. Zwitterionic polycarboxybetaine (pCB) is not only highly resistant to nonspecific protein adsorption, but also has abundant functional groups for the convenient and effective immobilization of biomolecules via conventional chemistry. This dual-functional property distinguishes pCB from other existing low-fouling materials, and enables diagnostics or molecular recognition in complex media. In this project, high-quality zwitterionic materials and coatings will be scaled up with low-cost and simple production process. The expected outcome is that one can immobilize molecular recognition elements directly onto a non-fouling background for a wide range of applications.

The broader/commercial impacts of this project will be the potential to offer an effective approach in protection of surfaces from unwanted interactions in complex media for biomedical and engineering applications. Zwitterionic technology has superior advantages of low cost, stability, effectiveness and additional functionalities. For protein interaction analysis and medical diagnostics, this technology will improve the sensitivity and specificity of a biosensor, and enable the detection of analytes in undiluted human blood plasma and serum.

Araca, Inc.

Phase II Award No.: 1152253

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Sector: Manufacturing Technologies

SBIR Phase II: Novel Slurry Injector Device for Chemical Mechanical Planarization Application

This Small Business Innovation Research (SBIR) Phase II project aims to develop a novel slurry injection device for applications in chemical mechanical planarization (CMP), a key technology for integrated circuit (IC) manufacturing. Different from the current slurry application method that applies slurry on the pad center area during wafer polishing, this novel slurry injector device is placed on top of the pad surface, injects the fresh slurry to where it is needed, and reduces slurry mixing and dilution effects by blocking used slurry, pad debris, and rinsing water from re-entering the pad-wafer interface. Tests will be performed on various polishers to optimize the slurry injector device design for different CMP processes. This slurry injector device is expected to achieve higher material removal rates and reduce polishing defects compared to current pad center area slurry application method.

The broader/commercial impacts of this project will be the potential to reduce slurry consumption and increase yield during CMP processes for the IC manufacturing industry. In 2012, the global point-of-use slurry usage is estimated to be in excess of 600 million liters corresponding to a total slurry expenditure of approximately $1 billion. Assuming a conservative slurry savings of 15 percent by this slurry injector device, it represents a potential $150 million savings in slurry and an additional $25 million savings in waste treatment.

Faraday Technology, Inc.

Phase II Award No.: 1057816

Award Amount: $500,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Sector: Manufacturing Technologies

SBIR Phase II: Faradayic ElectroCell

This Small Business Innovation Research (SBIR) Phase II project will address a current limitation in manufacturing of electronic devices. At the heart of electronic device manufacturing is the production of printed circuit boards (PCBs), which provide the mechanical support and electrical connection for electronic components. Many reliability issues associated with electronic devices result from non-uniformities in the electrodeposited copper on the PCBs. The drive for improved electronic device performance has necessitated shrinking PCB feature dimensions and increasing complexity of features, which has exacerbated this problem. The objective of this project is to develop sophisticated electrolyte flow schemes that will specifically target manufacturing issues associated with shrinking feature sizes and increased PCB complexity. The development and optimization of these sophisticated electrolyte flow schemes will enhance PCB reliability as well as improve manufacturing throughput for next generation electronic devices.

The boarder impact/commercial potential of this project is the production of robust,lower cost electronic devices, which are found in a vast number of end-products,including critical defense, monitoring and safety systems used by the US government and military. The market for electronic devices, estimated to be about a $1.3 trillion dollar industry, is formed by various sectors including computer and office equipment, communication equipment, portable and consumer electronics, medical and automotive electronics. This technology specifically addresses the manufacture of printed circuit boards, a critical component of all electronic devices, which were estimated to be a $53.6 billion market in 2009. A large commercial driver for the ElectroCell technology is the ability to manufacture PCBs at a higher rate, improving throughput and lowering manufacturing costs. This will translate into lower cost electronics for consumers.

Materials Innovation Technologies, LLC.

Phase II Award No.: 1127219

Award Amount: $499,159.00

Start Date: October 15, 2011
End Date: September 30, 2013

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Sector: Manufacturing Technologies

SBIR Phase II: Long Fiber Thermoplastic Composites from Recycled Carbon Fiber

This Small Business Innovation Research Phase II project will develop long fiber thermoplastic (LFT) compositions based on recycled carbon fiber. In Phase I, we demonstrated the ability to make high quality LFT formulations based on (1) waste carbon fiber and (2) composites scrap and end-of-life thermoplastic and thermoset carbon fiber composites. Mechanical properties of these composites were similar to, and in some cases superior to, those for virgin carbon fiber. In this project, we will continue to develop manufacturing capabilities to make both thermoset and thermoplastic composites. In this Phase II project, we will look at the following technical issues: (1) examining the use of new recycled fiber forms and comparing the results to prior data; (2) investigating the molding parameters associated with the "forging" of flat blanks of LFT; (3) optimizing the LFT compositions; (4) demonstrating consistent moldability and mechanical properties; and (5) demonstrating the conversion of molded LFT parts back into LFT compound to "close the loop" on recycling. This effort will feature partnerships with a not-for-profit composites laboratory and another small business, both of whom have extensive experience in developing LFTs using virgin carbon fiber.

The broader impact/commercial potential of this project includes a reduction in the amount of carbon fiber going into landfills and lower greenhouse gas emissions. Worldwide carbon fiber production is ~80 million pounds per year, with demand growing at ~15% annually. Conservatively, 20% of this fiber ends up as waste during composite manufacture (~16 million pounds/year) and is landfilled. The aerospace industry is a main consumer of this material (military aircraft, Boeing 787 and Airbus A380), but industrial, automotive, and recreational markets are also growing. However, few composite manufacturing processes are designed to work with chopped fibers, which is the primary form of recycled carbon fiber. Developing LFTs based on recycled carbon fiber will allow us to achieve "Three Shades of Green" by eliminating landfilling, reducing energy costs relative to virgin fiber, and improving sustainability. A significant business opportunity exists if manufacturing methods can be developed that use recycled fiber in the forms that are typical of reclaimed material. The potential market for composites made from recycled/reclaimed carbon fiber is more than $200 million. Finally, the amount of energy needed to recycle carbon fiber is only about 4% of that needed to make virgin fiber, reducing associated greenhouse gas emissions.

MicroGREEN Polymers, Inc.

Phase II Award No.: 1127360

Award Amount: $499,941.00

Start Date: September 15, 2011
End Date: August 31, 2013

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Sector: Manufacturing Technologies

SBIR Phase II: Continuous Production of Lightweight and Energy Efficient Solid-State Microcellular Panels from Recycled PET

This Small Business Innovation Research (SBIR) Phase II project aims to continuously produce multilayered microcellular from recycled polyethylene terephthalate (RPET) for rigid printing substrate applications. There is an increasing demand for sustainable substrates in the printing sector, which is America's third largest manufacturing industry. PET is the most recycled plastic in the United States. However, only 28% of the 5.15 billion pounds of water bottles used annually are currently recycled. Products made from RPET could utilize this untapped resource and in turn, could be recycled again, making them environmentally sustainable. The proposed approach is to fusion bond thin microcellular RPET sheets into thicker panels, thereby eliminating the need for a bonding adhesive, which in turn eliminates volatile organic compound (VOC) emissions that cause indoor air pollution. In Phase I of this project we established lab-scale feasibility for continuous fusion bonding of microcellular RPET sheets to produce such panels. In Phase II, we will build a production-scale laminator that is capable of producing microcellular RPET panels with a size of 4' x 8' at a speed of at least 8 feet/minute. The commercial feasibility of manufacturing this product will be established by developing a detailed cost model.

The broader impact/commercial potential of this project will be to satisfy the printing industry's rapidly growing need for sustainable products. The microcellular RPET panels to be developed are targeted for use in rigid printing substrate applications. Compared to current materials, the advantages of these panels include significantly higher post-consumer recycled (PCR) content, zero VOCs, premium printability without the need for surface treatment, enhanced barrier properties against mold/mildew/corrosion, excellent conformability, and compatibility with end-of-life recycling. The Phase II research will focus on using RPET as a raw material due to the immediate positive environmental and economic impacts. The resulting increase in the use of RPET in high-value applications will thereby provide an economic stimulus to the recycling industry. The results of this research will also expand the application frontiers for solid-state microcellular plastics technology and enable collaborative research to develop further markets for these lightweight materials in other industries such as construction, transportation, and maritime. Finally, the new technology resulting from this research will preserve resources for a sustainable environment, enhance the competitiveness of the US plastics industry, and create new job opportunities that will benefit society as a whole.

Mohawk Innovative Technology, Inc.

Phase II Award No.: 1127346

Award Amount: $433,699.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Sector: Manufacturing Technologies

SBIR Phase II: Ultrahigh Speed Micromachining Spindle

This Small Business Innovation Research (SBIR) Phase II project is directed towards the development of an ultrahigh speed micro-spindle for micro-machining. The proposed spindle for micro-milling and micro-grinding at speeds near 500,000 rpm will be implemented with existing commercial micro-machining systems. Micro-manufacturing refers to the creation of high-precision three-dimensional (3D) products using a variety of materials and possessing features with sizes ranging from tens of micrometers to a few millimeters. While micro-scale technologies are well established in the semiconductor and microelectronics fields, the same cannot be said for manufacturing products involving complex 3D geometry and high accuracies in non-silicon materials. The trends in industrial and military products that demand miniaturization, design flexibility, reduced energy consumption, and high accuracy continue to accelerate -- especially in the medical, biotechnology, telecommunications, and energy fields. The principal advantages of the proposed micro-spindle include higher production rates and precision obtained through the implementation of ultrahigh speed machining that will decrease the cutting forces and tool vibrations. The prototype micro-spindle will be evaluated in a series of alpha and beta testing with commercial micro-machining systems. The objective of Phase II is to perform the necessary R&D to prepare the micro-spindle for marketing.

The broader impact/commercial potential of this project encompasses the following. The ultrahigh speed micro-spindle will enable the production of cost-effective micro-components and will positively impact the micro-fabrication industry. Since the underlying scientific principles of micromachining at such high speeds are not known, the availability of the proposed spindle will allow for basic studies to uncover the response of materials under these conditions. Such basic information could lead to new scientific discoveries and further extend the micromachining processes. The data and information generated will undoubtedly be used in future for training of graduate students. The broad impact of this research includes expansion of micromanufacturing research, and research opportunities for next-generation scientific researchers and technology developers to pursue micro machining and micro manufacturing related efforts in the broader fields of micro positioning devices, micro die-and-mold manufacturing, micro sensing and monitoring systems, and micro factory integrations and optimization. Commercialization of the proposed micro-milling spindle will be instrumental in the development of new businesses and industries, and high value added jobs.

OG Technologies, Inc.

Phase II Award No.: 1058237

Award Amount: $538,000.00

Start Date: January 15, 2011
End Date: December 31, 2012

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Sector: Manufacturing Technologies

SBIR Phase II: IPPM:In-Line Piercing Process Monitoring For Seamless Tube Manufacturing

This Small Business Innovation Research Phase II project proposes to develop an imaging based monitoring system for the piercing process used in the manufacturing of seamless steel tubes based on the feasibility proven in Phase I. Piercing is the core process of the near net-shape manufacturing process for seamless tubes, which are crucial materials in many critical applications ranging from energy to chemical, automotive, aerospace, and infrastructure. However, being the primary cause for tube wall variations and internal surface quality issues,piercing is rarely investigated due to the lack of proper sensing means. There is a need to improve the piercing process efficiency for higher product quality and lower costs with new sensors. The proposed innovation consists of a set of imaging sensors for measuring the vibrations of the part being pierced. The vibration signals are used for system conditions monitoring for the detection of critical failure modes. The new approach was validated on selected tubes. Further development is proposed to support the commercialization of a new piercing-monitoring system. This project will be carried out by a team of industry-academia collaboration in 24 months. A site-tested prototype will be delivered.

The broader impact/commercial potential of this project is substantial. This project represents a unique approach of multi-model sensor fusion to controlling a highly stochastic and non-linear process. If commercialized, it may improve seamless steel tubing manufacture through reduced mill downtime, fewer setup pieces, and tightened tolerances, thereby reducing the pollution emissions and costly energy consumption associated with remanufacturing or reworking out-oftolerance products. Industry-wide adoption in the tube industry could yield drastic reductions in waste byproducts and cost savings of $250 million per year. Scientifically, the proposed research could have an impact on the adoption of emerging high dimensional data analysis techniques. The proposed project carries strong educational implication due to the close working relationship with the academia. Social impact is also expected with this project in improved energy preservation and environmental protection. The estimated benefits include energy savings of 3 terawatt-hours and reduction of 300,000 tons of carbon-equivalent emission and 260,000 tons of toxic waste per year. The estimated market size for the proposed iPPM system is $15 million in the US and $200 million globally. Beyond the piercing process, the success of the project will also provide generic modeling and analysis tools for systems with complex information.

OMAX Corporation

Phase II Award No.: 1058278

Award Amount: $447,679.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Sector: Manufacturing Technologies

SBIR Phase II: Development of Subminiature Abrasive-Waterjet Nozzles toward Micromachining

This Small Business Innovative Research (SBIR) Phase II project aims to develop micro abrasive-waterjet technology for automated machining features between 50 to 100 micrometers. The challenge lies in the development of nozzles with beam diameters less than 100 micrometers. Several issues must be resolved due to the complexity of the supersonic, 3-phase, and microfluidic flow through micro abrasive-waterjet nozzles in which capillary dominates gravity. The required size of abrasives is so small that they tend to clump together with poor flowability under gravity feed, causing intermittent abrasive feed and frequent nozzle clogging. New concepts initiated by the company to resolve the above issues has proven to be very effective. In parallel, novel accessories are being developed to further reduce the size of features that cannot be accomplished alone by the nozzles. The micro abrasive waterject nozzles and accessories will be mounted on a multi-nozzle platform to upgrade existing waterjet equipment for micromachining and for enhancing productivity and/or integrated into a micro Jet Machining Center by combining them with a low-power pump and a small footprint platform tailored for low-cost micromachining.

The broader/commercial impact of this project is the versatility of waterjet technology ("5M" - from macro to micro machining for most materials) is to develop a new product line of low-cost micrometer Jet Machining Centers. To meet the urgent need for the affordability of the healthcare system, commercialization of micro abrasive-waterjet technology for low-cost manufacturing of biomedical components for orthopedic implants will be explored. The micro abrasive-waterjet technology would also advantageously apply to manufacture components of green energy products and microelectronics. With global emphasis on R&D in micro-nano technology, micro-nano products will be available commercially soon. The micro abrasive-waterjet technology would help accelerate maturing of that technology. By relaxing precision requirements, the micro abrasive-waterjet could readily be turned into an affordable prosumer/consumer product superior to conventional tools for fabricating art, crafts and jewelry. Small job shops would benefit from the cost-effective micro abrasive-waterjet technology since the initial investment for getting into micromachining has been cost prohibitive.

Starfire Industries LLC

Phase II Award No.: 1127557

Award Amount: $500,000.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Program Director: Ben Schrag

Sector: Manufacturing Technologies

SBIR Phase II: Microwave Surface-Wave Plasma Source for Large-Area, High-Throughput, High-Quality Thin-Film Manufacturing for Solar Panels and Semiconductors

This Small Business Innovation Research (SBIR) Phase II project aims to develop a Plasma-Enhanced Chemical Vapor Deposition (PECVD) system for the deposition of silicon layers for a solar cell to absorb sunlight and convert to electricity. Current PECVD processes face challenges that limit the quality and speed at which the silicon thin film can be deposited. This translates into higher capital cost and less efficient photovoltaic modules, thus higher cost. In this project, a novel microwave surface-wave plasma source for the PECVD processing step will be developed. This source has the potential to increase deposition rates by 10 times over the current state of the art, while maintaining excellent film quality needed for high energy conversion efficiency and long lifetime. The expected outcome of this project is to offer a technology with high processing speed that is suitable to manufacture advanced tandem and triple-junction solar cells with high energy conversion efficiency.

The broader/commercial impacts of this project will be the potential to enable the manufacturing of high-efficiency thin-film silicon solar cells at costs meeting or exceeding the 2020 grid-parity goal of $1/Watt installed cost. Thin-film silicon uses earth-abundant, sustainable materials with inexhaustible supply of raw materials and no toxicity concerns. The solution provided by Starfire addresses a critical manufacturing challenge that has the potential to break the thin-film silicon bottleneck and enable its wide adoption. This technology can also be used in areas such as semiconductors and advanced lighting.

Thixomat

Phase II Award No.: 0847198

Award Amount: $773,733.00

Start Date: January 15, 2009
End Date: January 31, 2013

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

STTR Phase II: New Process for High Strength/Weight Net-Shape Auto and Aero components from Mg Sheet

This Small Business Technology Transfer (STTR) Phase II project aims to scale-up and commercialize a low cost and simple process to produce high strength/density Magnesium (Mg) alloy sheet; using Thixomolding Thermomechanical Processing (TTMP). TTMP avoids the decades-long barriers of twinning and shear band deformation that limits the formability of commercial coarse-grained Mg alloys, rather, in TTMP fine isotropic grains are molded in the first Thixomolding step and then these are thermomechanically processed to impose continuous dynamic recrystalization to finer grains of 0.8 to 2 microns. In this fine grained mode of processing, twinning and shear banding are minimized while slip and grain boundary sliding are promoted. The common intermetallic phases of Mg alloys are also refined to nanometer size so that they can serve as dispersion hardeners. The end result of the refined microstructures is an increase of both strength and ductility. The mechanism may apply also to Titanium (Ti) and Beryllium (Be) alloys.

The broader/commercial impacts of this project are fuel and pollution savings in automobiles and trucks; fuel and payload benefits in aerospace; energy savings in batteries and fuel cells; and medical benefits in bio-replaceable body implants. Commercially, this project will result in a new U.S. business in manufacture of superior low cost Mg sheet.

Topasol LLC

Phase II Award No.: 0924689
Phase IIB Award No.: 1145944

Award Amount: $606,691.00

Start Date: August 1, 2009
End Date: March 31, 2013

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Program Director: Prakash Balan

Sector: Manufacturing Technologies

SBIR Phase II: Low Cost-Reduced Risk Manufacturing Process For Nanocoatings

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project seeks to reduce the cost and risk of manufacturing nanoparticle/resin blends for coatings. Currently nanocoating resin manufacturing requires two steps; the first is the production of nanoparticles ex-situ of the coating resin using plasma or other energy intensive processes, and the second step is the addition of these nanopowders into the coating resin, usually by chemical processes and/or high energy mixing. Both steps are characterized by high cost, high environmental impact, or both. This new process reduces manufacturing steps, lowers cost and avoids direct exposure to hazardous nanopowders.

The broader impacts/commercial potential of this project is the creation of a roadmap for development of nanoparticle-containing coatings/composites by a one-step process. Potential cost savings are anticipated to be 25% or substantially more compared to existing processes. Coating performance enhancements not otherwise attainable are anticipated as well. Most importantly, health risks posed by inhalation of nanoparticulate powders, currently of unknown toxicity, are completely avoided. The largest potential of this project is the potential reduction of environmental, health and safety risks.

Triune Systems

Phase II Award No.: 1058114

Award Amount: $500,000.00

Start Date: January 1, 2011
End Date: December 31, 2012

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Sector: Manufacturing Technologies

SBIR Phase II: Micro-mark Data Matrix

This Small Business Innvation Research (SBIR) Phase II project will develop an Integrated Circuit (IC) authentication system as a countermeasure to the growing counterfeit IC problem. The goal is to leverage the extremely compact form factor of a patent-pending Micro Mark two dimensional (2D) direct part marking technology to apply permanent, unalterable, unique identification codes to individual IC packages. These codes will be generated from a centralized database then marked onto individual ICs such that they can be read and verified with the database throughout the subsequent supply chain to ensure traceability and authenticity. This Micro Mark technology is small enough (<25um) to fit on the vast majority of IC package form factors and provides sufficient code density to allow serialization.

The broader/commercial impacts of this project is to prevent the adverse effects of Integrated Circuit (IC) counterfeiting. ICs are a critical in the design of all electronic products and as our society becomes more and more dependent on electronic products for personal and business use it is important to ensure the correct operation of these products. This authentication system will enable manufacturers to ensure that the ICs they are deploying on their manufacturing lines are the authentic product. This system will also provide additional savings to the industry by reducing or eliminating the costs of manufacturing rework and product recalls due to counterfeit ICs. Moreover, as U.S. military electronic equipment has been infiltrated by counterfeit ICs, this authentication system will provide the systemic approach to stop the infiltration and preserve the performance of these military systems as they were designed and intended. As the technology matures, other industries which demand strict inventory control and efficient product recall (e.g. defense, pharmaceutical, legal, and forensic sciences) could also benefit from the Micro Mark Authentication System.

Uncopiers, Inc.

Phase II Award No.: 1127460

Award Amount: $500,000.00

Start Date: December 15, 2011
End Date: November 30, 2013

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Program Director: Ben Schrag

Sector: Manufacturing Technologies

SBIR Phase II: Clean Tool: A Unified Approach to Wafer Cleaning

This Small Business Innovation Research (SBIR) Phase II project aims to develop a single wafer processing clean tool for semiconductor wafer cleaning at all stages of wafer processing. The method relies on using acoustically controlled micro-cavitation to remove on-wafer particles. This is a chemical-free cleaning method, using ultra-pure water as the only processing fluid. During cleaning the particles will be counted as they get removed. The cleaning is deemed complete when there remain no more particles to be removed. The wafer will then be rinsed and dried in the same tool. This project is expected to provide a one-at-a-time wafer cleaning method with all the four functionalities of cleaning, inspection, rinsing and drying accomplished in a single setting.

The broader/commercial impacts of this project will be the potential to provide a complete environmentally-friendly solution to the wafer cleaning predicament. Cleanliness is a critical requirement in semiconductor manufacturing that directly impact the chip yields. Among all processing steps in semiconductor manufacturing, approximately one in every five processing steps is wafer cleaning. Perfect wafer cleaning is a significant, yet unsolved, problem in semiconductor industry, and the need is becoming more urgent as the technology moves towards sub-50nm design nodes. In this project, a wafer-cleaning tool will be developed to address this market need. This tool will also be useful in precision cleaning needed in the cleaning of lithography masks, Microelectromechanical Systems (MEMS), solar cells, flat panel displays, and hard disk drives (HDDs).

XRSciences LLC

Phase II Award No.: 1152704

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 21, 2014

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Sector: Manufacturing Technologies

SBIR Phase II: Rapid Clinker Analyzer (RCA)

This Small Business Innovation Research (SBIR) Phase II project aims to develop an on-line analyzer to enable the increased use of alternative fuels in cement manufacturing, and thus reduce energy costs. Cement manufacturing is highly energy-intensive, accounting for a significant portion of fuel use in the world. The rising cost of energy has motivated cement manufacturers to use alternative fuels available at low or no cost (e.g., tires, municipal waste etc.). However, the use of alternative fuels creates manufacturing problems due to the lack of adequate and timely analysis feedback. In this project, a Rapid Clinker Analyzer (RCA) will be designed, built and evaluated to demonstrate that the system captures and analyzes data in a much faster and cost-effective manner to allow cement manufacturers to analyze product clinker in near-real time.

The broader/commercial impact of this project will be the potential to significantly increase the use of alternative fuels in cement manufacturing. Widespread adoption of this technology will result in significant savings to cement manufacturers, while greatly reducing the use of fossil fuels. In addition, the shift to alternative fuels will reduce landfills, and thus mitigate negative environmental impacts of waste products. This new technology will also provide a unique advancement in analyzer technology because of the more rapid performance and smaller sample required.

Advanced Diamond Technologies

Phase II Award No.: 0823002
Phase IIB Award No.: 1039753

Award Amount: $991,546.00

Start Date: August 1, 2008
End Date: July 31, 2012

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Program Director: Ben Schrag

Sector: Nanotechnology

STTR Phase II: Diamond Nanoprobes for Atomic Force Microscopy - Imaging, Metrology, Material Property Measurement, Process Control, and Manipulation with Ultrahigh Performanc

This STTR Phase II project will develop commercially viable atomic force microscope (AFM) probes fabricated from ultrananocrystalline diamond. The project will refine the processes developed in Phase I and bring contact and non-contact all-diamond probes to market. Probes using conducting diamond that are chemically and electronically tunable and have superb tribological properties will also be developed.

This work will facilitate new industrial applications for AFM, including high-throughput imaging, metrology, and characterization of large quantities of materials, local electrical characterization for process control in micro/nanoelectronics, nanomechanical characterization of MEMS/NEMS devices, and ultraprecise hard mask correction for the micro/nanolithography industry.

Anasys Instruments Corp.

Phase II Award No.: 1126871

Award Amount: $500,000.00

Start Date: October 1, 2011
End Date: September 30, 2013

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: NanoIR: Infrared Chemical Spectroscopy at the sub-20 nm Scale

This Small Business Innovation Research (SBIR) Phase II project will involve research and development of infrared nanospectroscopy, leading to the first commercial instrument capable of infrared spectroscopy and chemical imaging at the sub-20 nm scale on a broad range of samples. We will develop and demonstrate key technologies to dramatically improve the resolution and sensitivity of atomic force microscope-based infrared spectroscopy (AFM-IR). Conventional infrared spectroscopy is the most widely used technique for chemical characterization, but fundamental limits prevent it from being applied at the nanoscale. The AFM has excellent spatial resolution, but until recently had no ability to perform chemical spectroscopy. AFM-IR has demonstrated infrared spectroscopy at well below conventional diffraction limits, but the current spatial resolution and sensitivity are on the order of 100-200 nm, and the method requires specialized sample preparation. This effort will expand on successful Phase I research to develop a robust instrument for obtaining high-resolution chemical spectra on a wide variety of samples with minimal sample preparation. This project will combine simulations with development of experimental techniques and prototype instrumentation to enable commercialization of infrared spectroscopy and chemical imaging down to the scale of single monolayers and individual molecules.

The broader impact/commercial potential of this project will be to give researchers a robust capability to leverage the power of infrared spectroscopy over broad wavelength ranges and at resolution scales well below current limits. Infrared spectroscopy is arguably the most widely used technique for chemical characterization, but spatial resolution limits have prevented it from being widely applied at the nanoscale. With billions of dollars of global investments in nanoscience and nanotechnology, the lack of IR nanospectroscopy technology leaves an enormous gap in needed characterization capabilities. The novel AFM-IR platform will enable a wide range of high-resolution characterization methodologies in materials science and life sciences including correlation of morphological, chemical, mechanical and optical properties. Based on specific early customer measurement requests, we anticipate significant downstream benefits in areas including the development of block co-polymers, advanced polymer nanocomposites, functional nanostructures, catalysts, materials for energy generation and storage, and many other areas.

Anasys Instruments Corp.

Phase II Award No.: 1152308

Award Amount: $499,955.00

Start Date: March 1, 2012
End Date: February 28, 2014

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Sector: Nanotechnology

SBIR Phase II: Nanoscale Ultrafast Dynamic Mechanical Analysis (nu-DMA)

This Small Business Innovation Research (SBIR) Phase II project will develop technologies to enable commercialization of nanoscale Dynamic Mechanical Analysis (DMA). Conventional DMA works by applying an oscillating stress to a sample and measuring the time-dependent strain. Analysis of DMA data gives information about material stiffness, viscosity, thermal transitions and activation energies, for example. DMA is a critical and widely used tool to measure the viscoelastic properties of bulk materials, but it suffers from three key limitations: slow speed, limited frequency range, and the lack of spatially-resolved information. Large and growing material classes employ nanoscale composite structures to achieve desired material properties. No current tool can rapidly examine the temperature-dependent viscoelastic response of these materials on the scales they are being engineered. To address this unmet need, we will extend successful Phase I research to develop instrumentation based on atomic force microscopy (AFM) using rapidly heatable AFM cantilever probes. Specifically, the nanoscale DMA platform will provide: (1) variable temperature DMA in seconds; (2) measurement frequencies three orders of magnitude higher than conventional DMA; (3) spatial resolution down to < 100 nm; and (4) sensitive and spatially-resolved measurements of glass transitions on wide range of commercially important polymers not previously measurable.

The broader impact/commercial potential of this project will stretch across multiple industries and academic research areas. Metrology and characterization are foundations of successful materials science and materials manufacturing. The lack of materials characterization tools at the nanoscale has been identified by the chemical industry as a key bottleneck for the rapid development of new materials. This proposal aims to fill a major gap in required instrumentation. With the ability to measure temperature-dependent viscoelastic properties at the nanoscale, materials scientists and engineers will be able for the first time to directly investigate local material stiffness, energy absorption, and damping in heterogeneous materials over a wide range of operating temperatures and frequencies. In addition to spatially resolved measurements, the dramatic measurement speed improvements (a thousand-fold improvement over conventional DMA) will enable higher measurement throughput, lower cost per measurement, more frequent sampling and better measurement statistics. Based on interactions with customers in diverse industries, we have already has already identified strong market pull in areas including epoxies, polymer blends, multilayer films, medical devices, semiconductor packaging, and aerospace markets.

Angstron Materials, LLC

Phase II Award No.: 1057999

Award Amount: $499,998.00

Start Date: March 15, 2011
End Date: February 28, 2013

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Sector: Nanotechnology

STTR Phase II: Large-Scale Production of Pristine Nano Graphene

This Small Business Technology Transfer (STTR) Phase II project aims to develop a method for rapid, direct and large-scale production of pristine nano-graphene platelets (NGPs). A combined molecular dynamic, macroscopic modeling and experimental approach will be used to (1) further improve the understanding of the underlying principles behind effective peeling of single-layer graphene sheets from graphite particles in selected liquid mediums, and (2) to clearly determine the most critical processing conditions that govern the graphene production rate in a continuous processing reactor.

The broader/commercial impacts of this project will be the potential to offer a cost-effective method to produce pristine nano-graphene in large quantities. NGPs are of exceptional scientific and technological significance. The ability to produce large-volume pristine nano-graphene will have a profound impact on the evolution of nano-graphene science and technology. Highly conductive graphene may find practical applications in transparent and conductive coating, supercapacitor, battery electrode, fuel cell bipolar plates, and conductive nanocomposite.

Chromation Partners

Phase II Award No.: 1152707

Award Amount: $490,207.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Sector: Nanotechnology

SBIR Phase II: A Photonic Crystal Based Spectrometer for Manufacturing Process Control

This Small Business Innovation Research (SBIR) Phase II project investigates an inexpensive ultra-compact optical spectrometer based on photonic crystal arrays. Current spectrometer technology, based on diffraction gratings, has pushed the limits of current manufacturing in terms of miniaturization, and has already benefited from economies of scale. In contrast, the photonic crystal spectrometer does not use diffractive grating optics, allowing significantly decreased size and cost. The photonic crystal spectrometer is a compact spectral sensing solution suitable for applications where grating spectrometers are too bulky or expensive and dye filter arrays do not offer the needed performance. In this project, the photonic crystal spectrometer module developed in Phase I will be further developed and customized for visible and UV applications. Low-resolution implementations targeting molecular absorption/emission applications will use extensions of the technology developed in Phase I. In addition, a new technology will be developed for high-resolution implementations targeting atomic absorption/emission. The anticipated results of this project are customizable spectrometer modules suitable for applications in water, biological, and chemical analysis, as well as other applications where a moderate number of spectral signals are indicative of state.

The broader impact/commercial potential of this project includes the expansion of low-cost spectroscopic techniques to applications which have previously been infeasible due to limitations in range or resolution of commercially available technologies. The commercial potential includes new handheld and portable instruments for chemical, photometric, and biological sensing. Photonic crystal spectrometers can be integrated into compact form factors that enable in situ measurement for manufacturing process analysis and in-process feedback control. Applications include solid-state lighting characterization and testing, emissions control, portable sensing, and personal health care. The electrochemical pH and oxidation-reduction potential (ORP) measurement market, a proxy for the pH sensing market addressed by this technology, was valued at $112 million in 2006. The platform spectrometer technology has the additional potential to be applied in other areas within the water testing market, which has an aggregate value of $4 billion.

ColdQuanta, Inc.

Phase II Award No.: 1126099

Award Amount: $483,931.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Sector: Nanotechnology

SBIR Phase II: Atom Chips for Cold and Ultracold Matter Applications

This Small Business Innovation Research (SBIR) Phase II project seeks to develop the next generation of atom chips for producing and manipulating ultracold atomic gases (temperatures < 1 μK). While atom chips developed in Phase I provided only magnetic control, these new hybrid atom chips will be able to manipulate ultracold matter both magnetically and optically. These chips will be incorporated into atom-chip vacuum cells, allowing optical techniques to be implemented in compact ultracold matter products. In Phase I, we developed silicon/glass wafers for both creating ultrahigh vacuum electrical feedthroughs with near perfect yield as well as in-trap imaging of ultracold matter. In Phase II, we will further develop this technology by incorporating miniature on-chip optical elements as a vehicle for bringing optical potentials (e.g. produced by laser beams) into the vacuum system. Our research plan includes redesigning existing chip layouts to accommodate small-sized optics that will be anodically bonded to silicon regions of the chip. To further enhance functionality, we will pursue both anti-reflection coating of atom chips and redesigns of the connectorization scheme used to bring electrical currents to the chip.

The broader impact/commercial potential of this project is to greatly expand the number and variety of experimental techniques that can be implemented with atom-chip vacuum cells. Of key interest here are optical techniques, such as optical lattices, used to trap and coherently control quantum mechanical systems (e.g. Bose-Einstein condensates). An important application of ultracold lattice-trapped atoms is interferometry, which can be used to realize gyroscopes, accelerometers, and gravimeters that are expected to be orders of magnitude more sensitive than current state-of-the-art technologies. Such devices are crucial for navigational positioning systems and satellite communications, and therefore are of great interest to both commercial and defense-oriented markets. Optical trapping is also vital for the next generation of neutral atomic clocks, whose accuracy is now exceeding a phenomenal 1 part in 10^17 (i.e. a loss of 1 second every 3 billion years). Optically trapped atoms are also ideal for implementing quantum information algorithms, and therefore have many applications in the emerging fields of quantum computation and information processing. For basic science, optical lattices have been used for precision measurements of fundamental constants, some of the most stringent tests of the Standard Model of Physics, and groundbreaking studies of many-body physics.

Cosmas

Phase II Award No.: 0956628

Award Amount: $502,913.00

Start Date: March 15, 2010
End Date: May 31, 2012

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Sector: Nanotechnology

STTR Phase II: A Simple and Innovative Approach to the Synthesis of Metal, Alloy, Metal Oxide, and Mixed-Metal Oxide Nanoparticles

This Small Business Technology Transfer (STTR) Phase II project aims to develop a manufacturing process to synthesize metal oxide, sulfide and other nanoparticles. The subject method simply involves mixing of common dry chemical starting materials and heating the resulting precursor material to a modest temperature. The objective is to demonstrate feasibility and scalability of this low-cost manufacturing process. Methods of dispersing aggregated particles in aqueous and polar solvents will be also be investigated.

The broader/commercial impact of this project will be the potential to offer a cost-effective and environmentally-friendly process to produce a broad spectrum of high quality nanoparticles. Current methods of making nanoparticles involve heavy energy consumption, large amounts of waste, and/or purification problems. The synthetic approach in this project has the potential to become the method of choice to supply novel nanoparticles in many low to high technology applications. It is anticipated to obtain nanoparticles with particle sizes less than 15 nm, size variations within ±10-20%, and purities as high as 99.9999%.

Inpria Corporation

Phase II Award No.: 1026885
Phase IIB Award No.: 1212316

Award Amount: $1,100,000.00

Start Date: June 15, 2010
End Date: May 31, 2014

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Directly Patternable Inorganic Hardmask for Nanolithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a robust, high-speed inorganic resist platform to revolutionize the manufacture of semiconductor devices with feature sizes < 30 nm. At present, there is no demonstrated organic or inorganic resist that satisfies all of the requirements - high speed, low line-width roughness (LWR), sufficient etch resistance - for patterning devices at these feature sizes. A fundamentally new approach, relying on depositing extremely high-quality oxide films from aqueous solution and very efficient photon-induced network-forming reactions, is being pursued. The approach has enabled the production of extremely small feature sizes and linewidth roughness, enabling optimization within a uniquely high-performance triangle of sensitivity, linewidth roughness, and resolution. Resist deposition, resist formulations, exposure conditions, and processing parameters will be examined in detail to simultaneously address International Technology Roadmap for Semiconductors (ITRS) roadmap requirements for 193i and extreme ultraviolet (EUV) lithography. Anticipated results include 26-nm line/space (L/S) resolution at 3 nm LWR with 193-nm exposures and double patterning, and 22-nm L/S resolution at 1.2 nm LWR with EUV exposures. This resist platform will also lead to a high-resolution electron beam resist with unprecedented sensitivity.

The broader/commercial impact of this project is to develop high-performance resist materials to fill critical unmet needs for semiconductor manufacturing with features smaller than 30 nm. The material being developed addresses two of the ITRS "difficult challenges" for lithography: an EUV resist that meets 22-nm half-pitch requirements, and the containment of cost escalation of the extension of 193 nm patterning. The resulting product will serve a quickly growing market with a combined opportunity of $250 million in 2015. Success in the project will have a considerable impact on continued productivity gains in the ITRS roadmap, which supports the electronics industry. New levels of device performance will be enabled, providing broad societal impacts through the introduction of advanced electronics, while enhancing prospects for domestic employment in advanced materials and semiconductor manufacturing. The broader scientific and engineering research communities will benefit from new techniques to build and study novel devices at the extreme end of the nanoscale. Finally, solution processing with aqueous materials will reduce the use of toxic solvents and permit a smaller carbon footprint from reduced reliance on vacuum process equipment.

Inpria Corporation

Phase II Award No.: 1152266

Award Amount: $500,000.00

Start Date: April 1, 2012
End Date: March 31, 2014

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Aqueous Precursors for High Performance Metal Oxide Thin Films

This Small Business Innovation Research (SBIR) Phase II project aims to develop spin-coatable liquid precursors for extremely high etch resistance pattern transfer layers (hardmasks) to enable novel devices in advanced integrated circuit manufacturing. The approach is to employ the fully inorganic metal oxide dielectric precursors demonstrated during the Phase I project to provide unparalleled etch selectivity for lithography spin-on hardmask layers. Such materials enable new architectures and deep etches required for future device generations which demand increasingly complex integration of materials to compensate for the limited etch selectivity of conventional organic patterning materials. The expected outcome is one or more inorganic spin-on hardmask materials ready for scale up to manufacturing.

The broader/commercial impact of this project will be the potential to provide materials to improve performance of integrated circuit devices manufactured at dimensions below 22 nm. This project addresses key challenges in the International Technology Roadmap for Semiconductors related to patterning requirements for future high performance electronic devices. The aqueous precursors are synthesized from environmentally benign raw materials, thereby reducing the environmental impact relative to conventional organic materials. The materials and low temperature processes developed in this project will also lay the foundation for broader applications in electronics, energy, and optical coatings.

Integrated Micro Sensors

Phase II Award No.: 1026825

Award Amount: $480,395.00

Start Date: September 15, 2010
End Date: August 31, 2012

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Sector: Nanotechnology

SBIR Phase II: Metamaterials for Giant Dielectrics and Energy Storage Solutions

This Small Business Innovation Research (SBIR) Phase II project aims to develop a core-shell nanoparticle architecture with metal nanoparticles as the high capacitance core, and polymers as the shell. The nanoparticles will be entrained in a broad spectrum of host polymers via a novel approach to produce high dielectric-constant films with minimum dielectric loss. To scale up this process without losing the unique and valuable properties of core-shell nanoparticles, a wet chemistry route with laser for selective polymerization will be utilized to coat each metal nanoparticle with a polymeric shell.

The broader/commercial impact of this project will be the potential to provide high-dielectric constant nanoparticles for the development of nanocomposite to meet future energy storage needs of supercapacitors. Currently, commercially available supercapacitors either have too low power or energy density or are too expensive to manufacture. This project is expected to enable the fabrication of ultra high energy storage capacitors by providing high energy and power density in a cost-effective manner.

Lumarray LLC

Phase II Award No.: 0923893
Phase IIB Award No.: 1152122

Award Amount: $734,975.00

Start Date: August 15, 2009
End Date: November 30, 2012

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Sector: Nanotechnology

SBIR Phase II: Dual-Wavelength Diffractive Optics for Absorbance-Modulation Optical Lithography

This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5). This Small Business Innovation Research (SBIR) Phase II project aims to develop an optical-maskless-lithography technology that is capable of high resolution, high throughput, flexibility, low cost, and extendibility. Current lithography technologies suffer from the problems of high tool costs, high mask costs, and inflexibility (in the case of optical-projection lithography), or high tool costs, very low throughputs, and high complexity (in the case of scanning-electron-beam lithography). The emerging Zone-Plate-Array-Lithography (ZPAL) technology and its optical extension to sub-100 nanometers via absorbance-modulation optical lithography (AMOL) will mitigate these issues, while providing unprecedented flexibility in nanopatterning. The proposed project covers three major thrusts: firstly, the manufacture of zone-plate arrays containing over 1000 zone plates, each with a numerical-aperture (NA) greater than 0.85; second, the manufacture of dichromat arrays containing over 1000 zone plates, each with a numerical-aperture (NA) greater than 0.85; and lastly, the design of high-efficiency lenses to overcome many of limitations of conventional zone plates and dichromats.

The broader impact/commercial potential of this project is the creation of a fabrication tool which will enable a new paradigm in the development and manufacture of nanostructures by sharply reducing the development-cycle time and manufacturing costs. At present, the tools that are available for the creation of such nanostructures are highly limited in flexibility, resolution, cost and throughput. Being maskless, this technology provides flexibility by enabling the designers of nanostructures to quickly realize their designs in hardware for prototyping and even low-volume manufacturing. This new tool could potentially benefit a wide spectrum of industries including micro-electro-mechanical devices (MEMs), nano-electro-mechanical devices (NEMs), nano-electronics, nano-magnetics, integrated optics, photonics, biochips, and microfluidics.

Lumarray LLC

Phase II Award No.: 1058417

Award Amount: $515,868.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Nanometer-Level Fidelity in Maskless Lithography

This Small Business Innovation Research (SBIR) Phase II project aims to develop a maskless photolithography system by ensuring that the patterns it writes are free of positional error (i.e., distortion) to the sub-1 nm level. In traditional photolithography, distortion minimization depends on the design and construction of an image-projection lens and on the fidelity of the mask. Measuring 1nm and sub-1nm geometric imperfections is intellectually challenging. In Phase I project, a confocal-metrology-system (CMS) was developed to determine focal spot positions from the phase of periodic signals produced when a master reference grating is scanned through the focal spots. In this Phase II project, corrections will be applied in the pattern-writing software. Errors in the X-Y position of the stage will be determined by comparing readings from a master reference grating with readings from the encoder built into the stage. Once known, systematic errors will be corrected in software through a process known as refracturing. The CMS will enable the systems located at disparate sites to reference a common fiducial, thus achieving identical patterning fidelity.

The broader/commercial impacts of this project will be the potential to provide a maskless photolithography tool with high fidelity for low-volume manufacturing of custom electronics and photonics, and for future nanomanufacturing. In comparison to existing electron-beam systems, this maskless photolithography tool will provide higher throughput, non-vacuum processing, large-area continuous patterning, lower cost and freedom from distortion to the sub-1nm level.

Lumeras

Phase II Award No.: 0848526
Phase IIB Award No.: 1159925

Award Amount: $789,937.00

Start Date: February 1, 2009
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Ultraviolet Laser for Ultra-high-resolution Photoemission Spectroscopy

This Small Business Innovation Research Phase II project is to develop a shortwavelength, narrow-bandwidth, high-brightness photo-ionization laser; that can be used for used for ultra-high energy-resolution, angle-resolved photoemission spectroscopy (ARPES), and for single-photon-ionization (SPI) in order to improve mass spectroscopy-based detection capabilities of complex organic molecules, especially low-vapor-pressure explosive compounds and trace residues.

The compact size, efficient optical conversion, and high brightness of the proposed laser source will enable integration into "field-ready", on-line mass spectrometry tools. The capabilities of the proposed single-photon-ionization light source will also complement a broad array of established mass-spectral analysis techniques to enable the development of instruments capable of analyzing heterogeneous samples with no a-priori knowledge of the sample composition. This capability is urgently needed for a variety of homeland security and non-proliferation applications.

nanoGriptech LLC

Phase II Award No.: 1152551

Award Amount: $500,000.00

Start Date: April 15, 2012
End Date: March 30, 2014

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Manufacturing of Bio-Inspired Polymer Micro/Nano-Fiber Arrays as New Gripping Materials

This Small Business Innovation Research (SBIR) Phase II project aims to develop a pilot-scale production system and process to enable the large-scale fabrication of continuous arrays of elastomeric micro/nano-scale fibers with complex geometry. Inspired by hairs that occur naturally on gecko feet, these micro/nano-scale elastomeric fibers demonstrate strong adhesive, shear, and peel strengths over a wide range of test substrates. Unlike other classes of adhesives such as pressure-sensitive tapes, these biologically-inspired adhesives can be repeatedly used over thousands of test cycles with very little contamination and performance degradation over the material lifespan. However, this class of material has only been able to be fabricated through expensive micro/nano fabrication processes including photolithography, chemical etching, or time-consuming batch micro/nano molding processes. In this project, a pilot-scale manufacturing system will be constructed, optimized and evaluated. A roller-based molding and peeling process for high-speed, continuous, and large-area manufacturing of high aspect-ratio and three-dimensional micro/nano-scale fibers with a compliant backing layer will be developed using elastomer materials.

The broader/commercial impacts of this project will be the potential to provide a low-cost, high-volume process to mass produce continuous arrays of elastomeric micro/nano-scale fibers with complex geometry for applications in apparel, sporting equipment, healthcare, defense, industrial clamping, and consumer goods. These fibers will provide strong reversible adhesive or enhanced shear interfaces that are resistant to contamination and maintain their adhesive ability over the product lifespan.

NaugaNeedles LLC

Phase II Award No.: 1058576

Award Amount: $500,000.00

Start Date: February 1, 2011
End Date: January 31, 2013

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Batch Fabrication of High Aspect Ratio Metallic AFM Probes

This Small Business Innovation Research (SBIR) Phase II project aims to develop a low-cost manufacturing process to produce conductive and high-aspect-ratio probes for atomic force microscopy (AFM). A new fabrication tool with high-precision alignment and in-situ process monitoring sensors will be designed and constructed. The probes (so-called NeedleProbes) will be fabricated in a batch process that can pattern an entire wafer of conventional AFM probes with freestanding metal alloy nanowire tips.

The broader/commercial impacts of this project will be the potential to provide affordable, conductive and high-aspect-ratio AFM probes that would be well suited in biology for cell scanning and probing, and materials science for imaging of ultra-high-aspect-ratio structures, and electronic measurement of nanostructures. The current fabrication method of AFM probes is a serial process that produces approximately five probes per hour. The advancement in this project toward batch fabrication is expected to extend far beyond the current fabrication method and result in a price reduction of the probes by a factor of 5.

Novan, Inc.

Phase II Award No.: 1127380

Award Amount: $499,987.00

Start Date: November 1, 2011
End Date: October 31, 2013

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Scale-up Manufacturing of Nitric Oxide Nanotechnology for Healthcare Infections

This Small Business Innovation Research (SBIR) Phase II project aims to develop the process and engineering controls necessary to scale up the manufacturing of a nitric-oxide-releasing active pharmaceutical ingredient (API). One of the applications is a wound-healing product for diabetic foot ulcers. This project will focus on 1) optimizing the process parameters required to scale production of a nitric-oxide-releasing API to reproducible 1 kg batches, and 2) implementing the analytical methodologies to meet the requirements of the Chemistry, Manufacturing and Control (CMC) sections of an Investigational New Drug (IND) application. The expected outcome is a manufacturing process capable of producing large batches of the API that are suitable for an IND submission of a wound-healing product for diabetic foot ulcers or other nitric-oxide-releasing drug.

The broader/commercial impacts of this project will be the potential to provide a new standard of care for the treatment of diabetic foot ulcers. Currently, there are no products that address both wound healing and infection in diabetic foot ulcers. Infection is particularly problematic in diabetic foot ulcers due to the lack of normal skin barrier function, long duration of wound exposure to the external environment (months to years), poor blood circulation to the extremities that limits the migration of inflammatory cells to the site of infection, and the recent understanding of biofilm formation which protects bacteria from topically applied antimicrobials and systemically administered antibiotics. Nitric-oxide-releasing wound-healing therapeutics have the potential of addressing both infection and healing in diabetic foot ulcers.

Optofluidics, Inc.

Phase II Award No.: 1151966

Award Amount: $499,591.00

Start Date: March 15, 2012
End Date: February 28, 2014

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Program Director: Ben Schrag

Sector: Nanotechnology

SBIR Phase II: Single Molecule NanoTweezers

This Small Business Innovation Research Phase II project aims to develop a commercial optically-resonant nanotweezer chip and corresponding instrumentation. The nanotweezer technology, originally developed at Cornell University, uses localized optical forces to directly manipulate biological (nucleic acids & proteins) and non-biological (nanoparticles) materials as small as a few nanometers in size. Efforts will be focused on developing a commercial system which facilitates the study of single-molecule interactions, as this sector has immediate market appeal and is experiencing very high growth. At present, research into the understanding of how single molecules interact is greatly impeded by the lack of a fast and simple technique which can: (1) capture and suspend small molecules in free solution for an indefinite period of time, (2) effectively "concentrate" the set of molecules of interest to a point where protein-protein or other multi-molecule interactions can be studied, and (3) allow rapid modulation of the external environmental conditions. The nanotweezer product line to be developed here, consisting of optical chips which carry the core technology, as well as a driving instrument, represents a quick and cost-effective system that allows researchers to solve all three of these problems simultaneously.

The broader impact/commercial potential of this project will be a commercially-available product that can directly manipulate extremely small biomolecules and particles, and could be transformative to scientific and industrial advancement in a number of areas including: (1) the understanding of faulty protein-protein events and other single-molecule interactions, (2) the analysis of individual nucleic acids for rapid sequencing, and (3) the directed assembly of new forms of nanomaterials for energy production. The importance of the first item (which is the target application for the initial version of this platform) is highlighted by the large number of sufferers of neurodegenerative disorders such as Alzheimer's and Parkinson's, which are diseases that have been linked by protein misfolding events. The development of tools that can facilitate experimental studies of how single biomolecules and small aggregates interact can reveal information about the fundamental molecular processes that lead to these deficiencies. The nanotweezer technology has a series of key advantages over existing commercial methods that can enable researchers to better understand these phenomena in environments closer to the physiological state. We believe that these advantages will create a significant commercial advantage over competing products.

Transfer Devices, Inc.

Phase II Award No.: 1126916
Phase IIB Award No.: 1232377

Award Amount: $975,000.00

Start Date: October 1, 2011
End Date: September 30, 2015

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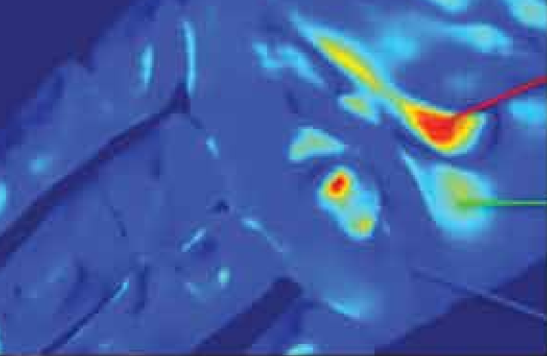
Program Director: Ben Schrag

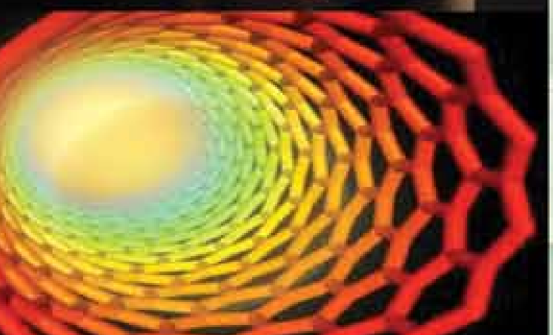
Sector: Nanotechnology

SBIR Phase II: Molecular Transfer Lithography of Functional Materials

This Small Business Innovation Research (SBIR) Phase II project aims to develop processes for high-resolution patterning of advanced functional materials by a patented technique called molecular transfer lithography. The approach is to use water-dissolvable templates of polyvinyl alcohol (PVA), which are replicated from master surface topography, coated with functional materials that are transferred to a substrate as an active component of the resulting nanopatterned device. A range of functional materials are considered including dielectrics, metal oxides, conductive inks, phosphors, ceramics, optical polymers, nanoparticle-loaded composite materials, sol-gels, specialized resists, monolayer and semi-permeable polymer films, and luminescent materials. In combination with a platform equipment technology, these processes for functional material patterning comprise a comprehensive nanolithography solution that should enable nanomanufacturing of a broad range of novel devices.

The broader/commercial impacts of this project will be the potential to enable the nanopatterning of various functional materials that previously were difficult, not possible, or too costly to produce as high-resolution features for integration in advanced devices. Lithography technology, approximately a $10 billion market opportunity, creates dense circuitry and related nanostructures for high performance devices including semiconductors, displays, data storage, solid state lighting, solar cells, and biological sensors. In this project, the lithography procedure, which uses water-dissolvable templates and dry functional materials, enables an environmentally-friendly approach to high-resolution patterning, a foundational step in advanced manufacturing.



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